

No. 2023-1194

**United States Court of Appeals  
for the Federal Circuit**

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MAXELL, LTD.,  
*Plaintiff-Appellant*

v.

AMPEREX TECHNOLOGY LIMITED,  
*Defendant-Appellee*

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On appeal from the United States District Court  
for the Western District of Texas, Nos. 6:21-cv-00347-ADA,  
6:21-cv-01007-ADA  
Hon. Alan D. Albright

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**RESPONSE BRIEF OF APPELLEE**

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March 31, 2023

**Claim 1 of U.S. Patent No. 9,077,035**

1. A nonaqueous secondary battery comprising:

a positive electrode having a positive electrode mixture layer, a negative electrode, and a nonaqueous electrolyte,

wherein the positive electrode comprises, as active materials, at least two lithium-containing transition metal oxides having different average particle sizes, and the lithium-containing transition metal oxide having the smallest average particle size is a lithium-containing transition metal oxide represented by the formula (1):



wherein **M<sup>1</sup> represents at least one transition metal element selected from Co, Ni and Mn**, M<sup>2</sup> represents Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn, M<sup>3</sup> represents at least one element selected from the group consisting of Na, K, Rb, Be, Ca, Sr, Ba, Sc, Y, La, Hf, V, Ta, Cr, Mo, W, Tc, Re, Fe, Ru, Rh, Cu, Ag, Au, B, Ca, In, Si, P and Bi, and x, y, z and v are numbers satisfying the equations respectively:  $0.97 \leq x < 1.02$ ,  $0.8 \leq y < 1.02$ ,  $0.002 \leq z \leq 0.05$ , and  $0 \leq v \leq 0.05$ , and has an average particle size from 2  $\mu\text{m}$  to 10  $\mu\text{m}$ , and the lithium-containing transition metal oxide having the largest average particle size is a lithium-containing transition metal oxide represented by the formula (2):



wherein M<sup>1</sup>, M<sup>2</sup> and M<sup>3</sup> are the same as defined in the formula (1), and a, b, c and d are numbers satisfying the equations respectively:  $0.97 \leq a < 1.02$ ,  $0.8 \leq b < 1.02$ ,  $0.0002 \leq c \leq 0.02$ , and  $0 \leq d \leq 0.02$ , and has an average particle size from 5  $\mu\text{m}$  to 25  $\mu\text{m}$ ,

wherein said electrolyte contains a fluorine-containing organic solvent,

**wherein the content of Co in the transition metal M<sup>1</sup> of the formulae (1) and (2) is from 30% by mole to 100% by mole,**

wherein the content of said lithium-containing transition metal oxide having the smallest average particle size in the lithium-containing

transition metal oxides is from 5% by weight to 60% by weight,  
wherein the content of said lithium-containing transition metal oxide  
having the largest average particle size in the lithium-containing  
transition metal oxides is from 40% by weight to 95% by weight, and  
wherein an amount of said fluorine-containing organic solvent is 0.1% by  
weight to 30% by weight based on the whole weight of the electrolyte.

FORM 9. Certificate of Interest

Form 9 (p. 1)  
March 2023

**UNITED STATES COURT OF APPEALS  
FOR THE FEDERAL CIRCUIT**

**CERTIFICATE OF INTEREST**

**Case Number** 2023-1194

**Short Case Caption** Maxell, Ltd. v. Amperex Technology Limited

**Filing Party/Entity** Amperex Technology Limited

**Instructions:**

1. Complete each section of the form and select none or N/A if appropriate.
2. Please enter only one item per box; attach additional pages as needed, and check the box to indicate such pages are attached.
3. In answering Sections 2 and 3, be specific as to which represented entities the answers apply; lack of specificity may result in non-compliance.
4. Please do not duplicate entries within Section 5.
5. Counsel must file an amended Certificate of Interest within seven days after any information on this form changes. Fed. Cir. R. 47.4(c).

I certify the following information and any attached sheets are accurate and complete to the best of my knowledge.

Date: 03/31/2023

Signature: /s/ Harold H. Davis, Jr.

Name: Harold H. Davis, Jr.

## FORM 9. Certificate of Interest

Form 9 (p. 2)  
March 2023

| <b>1. Represented Entities.</b><br>Fed. Cir. R. 47.4(a)(1).                             | <b>2. Real Party in Interest.</b><br>Fed. Cir. R. 47.4(a)(2).  | <b>3. Parent Corporations and Stockholders.</b><br>Fed. Cir. R. 47.4(a)(3).  |
|---|--|--|
| Provide the full names of all entities represented by undersigned counsel in this case. | Provide the full names of all real parties in interest for the entities. Do not list the real parties if they are the same as the entities.<br><br><input checked="" type="checkbox"/> None/Not Applicable | Provide the full names of all parent corporations for the entities and all publicly held companies that own 10% or more stock in the entities.<br><br><input type="checkbox"/> None/Not Applicable |
| Amperex Technology Limited  |  | TDK Corporation  |
|   |  | TDK HongKong Company Limited   |
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☐ Additional pages attached

FORM 9. Certificate of Interest

Form 9 (p. 3)  
March 2023

**4. Legal Representatives.** List all law firms, partners, and associates that (a) appeared for the entities in the originating court or agency or (b) are expected to appear in this court for the entities. Do not include those who have already entered an appearance in this court. Fed. Cir. R. 47.4(a)(4).

☐ None/Not Applicable ☒ Additional pages attached

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**5. Related Cases.** Other than the originating case(s) for this case, are there related or prior cases that meet the criteria under Fed. Cir. R. 47.5(a)?

☒ Yes (file separate notice; see below) ☐ No ☐ N/A (amicus/movant)

If yes, concurrently file a separate Notice of Related Case Information that complies with Fed. Cir. R. 47.5(b). **Please do not duplicate information.** This separate Notice must only be filed with the first Certificate of Interest or, subsequently, if information changes during the pendency of the appeal. Fed. Cir. R. 47.5(b).

**6. Organizational Victims and Bankruptcy Cases.** Provide any information required under Fed. R. App. P. 26.1(b) (organizational victims in criminal cases) and 26.1(c) (bankruptcy case debtors and trustees). Fed. Cir. R. 47.4(a)(6).

☒ None/Not Applicable ☐ Additional pages attached

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**CERTIFICATE OF INTEREST**  
**ADDITIONAL PAGES**

Case Number: 2023-1194  
Short Case Caption: Maxell, Ltd. v. Amperex Technology Limited  
Filing Party/Entity: Amperex Technology Limited

**4. Legal Representatives.** List all law firms, partners, and associates that (a) appeared for the entities in the originating court or agency or (b) are expected to appear in this court for the entities. Do not include those who have already entered an appearance in this court. Fed. Cir. R. 47.4(a)(4).

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## STATEMENT OF RELATED CASES

Pursuant to Federal Circuit Rule 47.5(a), counsel for Appellee Amperex Technology Limited (“ATL”) discloses that the following appeals in or from the same civil actions were previously before this Court:

- *In re: Amperex Technology Ltd.* (No. 2022-105): Petition for writ of mandamus denied January 14, 2022 in a per curiam order by Judges Lourie, Prost, and Taranto. *In re Amperex Tech. Ltd.*, No. 2022-105, 2022 WL 135431 (Fed. Cir. Jan. 14, 2022).
- *Amperex Technology Limited v. Maxell, Ltd.* (No. 2022-1017): Appeal withdrawn following above-referenced denial of petition for writ of mandamus. *Amperex Tech. Ltd. v. Maxell, Ltd.*, No. 2022-1017, 2022 WL 1021590 (Fed. Cir. Jan. 21, 2022).

Pursuant to Federal Circuit Rule 47.5(b), ATL discloses that the following cases will directly affect or be directly affected by this Court’s disposition of this appeal:

- *Amperex Technology Limited v. Maxell, Ltd.*, No. IPR2021-01441 (PTAB).
- *Zhuhai CosMx Battery Co., Ltd. v. Maxell, Ltd.*, No. IPR2022- 00985 (PTAB).
- *Maxell, Ltd. v. Zhuhai CosMx Battery Co., Ltd.*, No. 6:21-cv- 00845-ADA (W.D. Tex.).

Since the filing of this appeal, in IPR2021-01441 the PTAB held all claims of the ’035 Patent invalid over prior art. Appx2387-2430 (final

written decision). An affirmance here would moot a potential Maxell appeal of the PTAB's decision.

Also since the filing of this appeal, the two listed cases involving Zhuhai CoxMX Battery Co., Ltd. have been resolved by settlement. They are listed here only because there are not yet final dismissals on their respective dockets.

Counsel for ATL is not aware of any other related cases within the meaning of Federal Circuit Rule 47.5.

### **STATEMENT OF THE ISSUE**

As Maxell admits, Claim 1 of the '035 Patent on the one hand states that M<sup>1</sup> "could be any one of [Co, Ni, Mn] alone, or any combination of those three metals," but on the other hand expressly requires M<sup>1</sup> to contain at least 30% cobalt. In light of this facial contradiction, did the district court correctly hold that Claim 1 (and therefore all other claims that depend on Claim 1) is indefinite?

## STATEMENT OF THE CASE

### I. Introduction

Under 35 U.S.C. § 112, ¶ 2, a patentee must describe his invention with sufficient particularity that the public will understand its metes and bounds.

As the court below found, Claim 1 of the '035 Patent (the only independent claim) is indefinite because it recites a logical impossibility: on its face, the claim says that cobalt is both optional and required. A paradox by definition has no metes and bounds.

No amount of argument can overcome this fundamental problem with Maxell's patent. Because the plain language of the patent is contradictory, the patentee failed to properly claim the invention of the '035 Patent. The claims are indefinite and invalid.

### II. Background of the Dispute

Founded in 1999, Amperex Technology Limited ("ATL") is the world's leading innovator and (by some measures) largest manufacturer of lithium-ion batteries. Appx1345-1346, ¶¶ 23-24. By contrast, appellant Maxell. Ltd. no longer maintains a significant presence in the industry. *Id.*

In March 2020, Maxell contacted ATL and alleged that ATL's

lithium-ion battery products infringe its U.S. Patent Nos. 8,691,446 (“446 Patent”), 9,077,035 (“035 Patent”), 9,166,251 (“251 Patent”), and 9,350,019 (“019 Patent”) (collectively, the “Maxell LIB Patents”). *Id.* ¶25. The ’446, ’035, and ’019 Patents date to 2006 and share the same specification. The ’251 Patent shares much of the specification language of the other LIB Patents, but claims a 2007 priority date, is directed to a separator rather than a finished battery, and comes from a different inventive entity.

Despite a year of negotiations, Maxell could not accept that ATL products do not infringe the Maxell LIB Patents and therefore ATL filed a declaratory judgment action of non-infringement in New Jersey, Maxell’s U.S. base of operations. Appx1341-1430 (*Amperex Tech. Ltd. v. Maxell, Ltd.*, D.N.J. Case No. Civ. 21-08461, ECF 1). Maxell countersued in the Western District of Texas, Appx1431-1565 (W.D. Tex. Case No. 6:21-cv-347-ADA), and after motion practice (and an unsuccessful mandamus petition), the cases were consolidated in Waco. See generally *Amperex Tech. Ltd. v. Maxell, Ltd.*, 2021 WL 4398804 (D.N.J. Sept. 27, 2021); *In re Amperex Tech. Ltd.*, No. 2022-105, 2022 WL 135431 (Fed. Cir. Jan. 14, 2022); Appx1996-1997.

### **III. The District Court Held that Claim 1 of the '035 Patent is Invalid Because the Term at Issue is Indefinite**

Following transfer and consolidation, the parties engaged in an extensive claim construction process in the Western District of Texas. The parties identified ten disputed claim terms for construction before the district court, many of them appearing across all four patents. In advance of the claim construction hearing, the court provided its preliminary claim constructions, including a finding that the '035 Patent was indefinite. The court gave Maxell ample opportunity to consider the preliminary finding of indefiniteness prior to the oral argument.

As the court below explained, the '446, '035, and '019 Patents “are all entitled ‘Nonaqueous secondary battery and method of using the same,’” are “directed to similar technology[,] and share[] many of the same terms.” Appx0027. “Each of these patents describes a lithium-ion battery whose positive electrode includes at least two lithium-containing transition metal oxides with different average particle sizes.” *Id.* According to the (highly similar) specifications of each patent, using two lithium-containing transition metal oxides (LCTMOs) with different average particle sizes and different specific molar ratios of lithium, oxygen, and one or more transition metals “allows the battery



manufacturer to increase the number of lithium-containing transition metal oxides in the same volume, which allows for a more compact battery, as well as greater energy efficiency.” *Id.*

In the '035 Patent, the formula for LCTMO (1) is  $\text{Li}_x\text{M}^1_y\text{M}^2_z\text{M}^3_v\text{O}_2$ . The claim states that “M<sup>1</sup> represents at least one transition metal element selected from Co, Ni and Mn” *and* “the content of Co in the transition metal M<sup>1</sup> ... is from 30% by mole to 100% by mole.” Appx0138, Cl. 1. Maxell engages in subliminal messaging by conflating these phrases as a single “Cobalt Term.” They are more properly the “M<sup>1</sup> Terms,” which is how ATL will refer to them unless directly quoting Maxell. The contradiction is plain: if M<sup>1</sup> represents *at least one* transition metal element selected from the three alternatives Co, Ni and Mn, then M<sup>1</sup> could “select” only Co, Ni, or Mn, some combination of two of these three, or all three. But in several of these alternatives, the content of Co in the transition metal M<sup>1</sup> would be 0. Since the claim *also* requires that the content of Co in M<sup>1</sup> be from 30% by mole to 100% by mole, M<sup>1</sup> *cannot* represent “at least one” transition metal “selected from” Co, Ni and Mn. These two phrases cannot be aligned.

Maxell argued at claim construction that the M<sup>1</sup> Terms are definite

in light of the patent's file history. To support its position, Maxell presented the district court with twelve slides walking through the USPTO's office actions during the prosecution of the '035 Patent. It also submitted a declaration from its expert, Brett Lucht. Appx1778 (Lucht Dec. ¶ 72).

The district court disagreed. In its final claim construction order, the court held that the M<sup>1</sup> Terms in the '035 Patent are indefinite. Appx0068-72. It specifically summarized Maxell's prosecution argument before rejecting it, writing:

Plaintiff contends that the prosecution history supports its position as Co was in the originally filed claims. Plaintiff then contends that Applicant amended the claim to create *Markush* group by adding Ni and Mn as additional elements and to require that Co is 30% to 100%. Plaintiff further contends that Applicant distinguished the pending claim from prior art by arguing that "Oda et al. JP '507 does not describe or teach such a content of Co, since Oda et al. JP '507 predominantly uses Ni as a transition metal."

Appx0069 (record citations omitted). But the trial court concluded that "there is clear-and-convincing evidence that a POSITA would not understand with 'reasonable certainty' what [the M<sup>1</sup> Terms] require[]." Appx0071. It found that "the first part of the claim recites a *Markush* group where Co is not necessarily required to be in the claimed compound

while the second part of the claim recites that Co is necessarily required. For an element to simultaneously be optional and required is a contradiction on its face.” Appx0070.

The district court also rejected Maxell’s interpretation that the claim “constitutes a *Markush* group wherein M<sup>1</sup> represents [1] Co, or [2] Co and at least one transition metal element selected from the group consisting of Ni and Mn.” Appx0071. To the contrary: “[R]ather than describe two options where Co is part of both options, the claim ... recites a *Markush* group where there are up to seven options (Co, Ni, Mn, Ni & Mn, Co & Mn, Co & Ni, Co & Ni & Mn) where Co is only present in four of the seven options.” *Id.*

The court below also disagreed that Claim 1 recites a broad limitation (*Markush* group) that is narrowed by another limitation (30%-100% Co). The court reasoned that “the first part of the claim recites a broad claim with seven options, but then the second part of the claim recites a narrowing limitation that does not apply to all options. In other words, the second part of the claim does not narrow the first part of the claim as it does not apply to some *Markush* group combinations.” *Id.*

Reading the claim terms together and considering similar claim

language used in the related '019 Patent, the district court found that Maxell knew exactly “how to draft a claim that allow[s] for two options, both of which could have included Co.” Appx0071-72. But “Plaintiff chose not to do so for this claim term, thus supporting the Court’s conclusion of indefiniteness.” *Id.*

This point alone warrants affirmance. If Maxell had intended that Co be a required element of M<sup>1</sup>, it knew how to say so. In fact, it did so even within the M<sup>1</sup> Terms themselves. In Claim 1 of the '035 Patent, Maxell defined the *second* transition metal in LCTMO (1) to require Mg: “M<sup>2</sup> represents *Mg and at least one metal element* selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn.” Appx0138, Cl. 1 (emphasis added). Similarly, the related '019 and '446 Patents say that “M<sup>2</sup> represents *Mg, or Mg and at least one metal element* selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn.” Appx1526 ('019 Patent, Cl. 1); Appx1506 ('446 Patent, Cl. 1) (emphasis added). Either of these formulations, applied to the M<sup>1</sup> Terms, would have made it clear to a POSITA that M<sup>1</sup> requires some amount of Co. But Maxell instead defined M<sup>1</sup> to be “at least one” of Co, Ni and Mn—a phrase inconsistent with the later stipulation that it requires 30%-100% Co.

On March 9, 2022, Maxell filed its Opposed Motion for Partial Reconsideration of the Court's Claim Construction Order or, Alternatively, Entry of Partial Final Judgment. *See* Appx0095 (district court docket; the motion for reconsideration is listed as ECF 79). In that motion, Maxell repeated the arguments it presented during claim construction. The trial court was unconvinced: "Having considered the Motion, defendant [ATL's] opposition ..., Maxell's reply ..., as well as the arguments of the parties at a hearing held on July 17, 2022, the Court declines to reconsider its claim construction order ... and finds that Maxell's request for partial reconsideration of the Order should be, and hereby is, **DENIED.**" Appx0018. Consequently, the court granted summary judgment "[a]s all claims of the '035 Patent are indefinite...." Appx0019.

#### **IV. The PTAB Determined that All Claims of the '035 Patent Are Unpatentable**

On September 23, 2021, ATL filed a petition for *inter partes* review of all claims of the '035 Patent. Appx2304-86 (IPR2021-01441). On January 10, 2023, the Patent Trial and Appeal Board ("PTAB") held oral arguments on this petition, as well as petitions challenging Maxell's other patents in suit. Given the relatedness of the patents, oral

arguments for the '035, '019, and '446 Patents were consolidated in a single hearing.

On March 28, 2023, the PTAB issued a Final Written Decision determining that all challenged claims of the '035 Patent are unpatentable over the cited prior art. Appx2387-2430 (final written decision). The PTAB also determined that all challenged claims of Maxell's other patents in suit are invalid.

The PTAB's final written decision provides an independent basis to affirm the judgment of invalidity. *Granite Mgmt. Corp. v. United States*, 416 F.3d 1373, 1378 (Fed. Cir. 2005) ("An appellee may rely upon any ground supported by the record for affirmance of the judgment, whether or not the lower court relied on that ground."); *Banner v. United States*, 238 F.3d 1348, 1355 (Fed. Cir. 2001) ("An appellate court 'may affirm the district court on a ground not selected by the district judge so long as the record fairly supports such an alternative disposition of the issue.'").

## SUMMARY OF THE ARGUMENT

The Court should affirm the trial court’s judgment that Claim 1—the only independent claim of the ’035 Patent—is indefinite.

“In construing claims, *the analytical focus must begin and remain centered on the language of the claims themselves*, for it is that language that the patentee chose to use ‘to particularly point[] out and distinctly claim[] the subject matter which the patentee regards as his invention.’” *Golight, Inc. v. Wal-Mart Stores, Inc.*, 355 F.3d 1327, 1331 (Fed. Cir. 2004) (internal quotation marks omitted and emphasis added). The court below correctly found, and Maxell admits, that the M<sup>1</sup> Terms in Claim 1 at once says that M<sup>1</sup> “could be any one of [Co, Ni, Mn] alone, or any combination of those three metals,” but also expressly requires M<sup>1</sup> to contain at least 30% cobalt. Appellant’s Br. (ECF 11) at 33-34; Appx0070-71; Appx1753 (Fuller Dec.) ¶¶ 49, 50.

This logical impossibility cannot possibly reflect what the applicants regarded as their invention. Faced with these contradictions, a POSITA is unable to determine what, exactly, are the parameters of M<sup>1</sup>. Appx0071; Appx1753 (Fuller Dec. ¶¶ 49-50). The insoluble ambiguity of the M<sup>1</sup> Terms is further demonstrated by Maxell’s own changing

position of what the M<sup>1</sup> Terms mean in its arguments before the district court and this Court.

If Maxell wanted to claim that M<sup>1</sup> represents Co alone or Co ***and*** some combination of Ni and Mn—instead of “*at least one* transition metal element *selected from* Co, Ni and Mn”—it knew exactly how to do so. For example, in claiming that the M<sup>2</sup> alloy requires Mg, the ’035, ’019, and ’446 Patents all recite: “M<sup>2</sup> represents ***Mg and at least one metal element*** selected from” different options, which clearly requires Mg. Appx1526 (’019 Patent, Cl. 1); Appx1506 (’446 Patent, Cl. 1) (emphasis added). This Court’s precedent instructs that different claim terms are presumed to have different meanings and Maxell has presented no persuasive evidence to rebut this presumption. “Where the meaning of a claim term is clear, as it is here, we do not rewrite the claim to preserve its validity.” *Hill-Rom Servs. v. Stryker Corp.*, 755 F.3d 1367, 1374 (Fed. Cir. 2014).

Maxell argues (repeatedly) that the M<sup>1</sup> Terms define the “potential” components of M<sup>1</sup> without requiring that every possible combination is available. Appellant’s Br. (ECF 11) at 11, 33, 44. Maxell’s argument runs afoul of the tenet that the public is entitled to reasonable notice of the



asserted property interest—by requiring that the claims “particularly point out” and “distinctly claim” the invention. 35 U.S.C. § 112.

Maxell’s “berry pie” analogy is misleading because it deliberately departs from the structure of the ’035 Patent claims. *See* Appellant’s Br. (ECF 11) at 4. An analogy that better fits the wording of the terms at issue would be: Suppose a recipe for “berry pie” said “(1) the filling is *at least one fruit selected from* blueberries, raspberries, and strawberries” and “(2) the content of blueberries in the filling is between 30% and 100%.” Instead of understanding the recipe required blueberries, an ordinary speaker of English would likely push the recipe aside as confusing and contradictory.

Nothing in the intrinsic record indicates that the inventors have manifestly disclaimed or disavowed the full scope of the *Markush* group recited by Claim 1. The Court does not need to consider the specification or prosecution history because the parties on appeal do not dispute the plain and ordinary meaning of the M<sup>1</sup> Terms. *Johnson Worldwide Assocs., Inc. v. Zebco Corp.*, 175 F.3d 985, 989 (Fed. Cir. 1999) (there is a “heavy presumption in favor of the ordinary meaning of claim language”). And the claim “frames and ultimately resolves all issues of claim

interpretation.” *Teleflex, Inc., v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1324 (Fed. Cir. 2002).

Where, as here, the ordinary meaning of claim language as understood by a POSITA is readily apparent even to lay judges, claim construction involves little more than the application of the widely accepted meaning of commonly understood words. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1314 (Fed. Cir. 2005). The fact that the patent’s examples of M<sup>1</sup> all contain Co does not matter, because the specification particularly states that “the Examples do not limit the scope of the present invention.” Appx0134 (’035 pat. at 21:37-38). Nor does the prosecution history contain “a clear disavowal of scope” that Maxell can rely on to rescue its claims.

Because Claim 1 fails in the basic task of explaining what is claimed, the Court should affirm that it is invalid under 35 U.S.C. § 112.

## ARGUMENT

### I. Standard of Review

This Court “review[s] the district court’s ultimate conclusion of indefiniteness under 35 U.S.C. § 112 de novo.” *Eon Corp. IP Holdings LLC v. AT&T Mobility LLC*, 785 F.3d 616, 620 (Fed. Cir. 2015). “Because the indefiniteness inquiry here is intertwined with claim construction,” however, the Court reviews any “subsidiary factual determinations for clear error.” *Id.* Thus, unless the Court has “a definite and firm conviction that a mistake has been committed,” such “factual findings ... are not to be disturbed.” *Flex-Rest, LLC v. Steelcase, Inc.*, 455 F.3d 1351, 1357 (Fed. Cir. 2006) (quotation omitted).

Under § 112 ¶ 2, “first, [the claim] must set forth what the applicant regards as his invention and second, it must do so with sufficient particularity and distinctness, i.e., the claim must be sufficiently definite.” *Allen Eng’g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks omitted).

The patentee has the burden to claim an invention with sufficient particularity and precision to “inform the public of the bounds of the protected invention, i.e., what subject matter is covered by the exclusive rights of the patent.” *Halliburton Energy Servs., Inc. v. M-I LLC*, 514

F.3d 1244, 1249 (Fed. Cir. 2008). Where a patentee has failed to claim his invention with sufficient precision for “one skilled in the art [to] understand the bounds of the claim,” the claim is indefinite and must be declared invalid.” *Allen Eng’g Corp.*, 299 F.3d at 1348.

## **II. The M<sup>1</sup> Terms Contain A Contradiction That Renders Claim 1 Indefinite**

Claim 1 of the ’035 Patent is the patent’s only independent claim. It contains two different statements concerning how much cobalt is required in the transition metal labeled “M<sup>1</sup>” (part of a formula for the lithium-containing transition metal oxides in the claimed battery’s cathode). In the first portion of the claim defining M<sup>1</sup> in formulas (1) and (2), the ’035 Patent states that “M<sup>1</sup> represents at least one transition metal element selected from Co, Ni and Mn.” Appx0138, Cl. 1. In the second portion of the claim defining M<sup>1</sup> in formulas (1) and (2), the ’035 Patent states that “the content of Co in the transition metal M<sup>1</sup> of the formulae (1) and (2) is from 30% by mole to 100% by mole.” *Id.* The district court correctly held that this contradiction in the M<sup>1</sup> Terms renders the claim indefinite. Appx0070.

The most important source of intrinsic evidence is the language of the claims because a patent’s claims define the scope of the patentee’s

right to exclude. *See Haemonetics Corp. v. Baxter Healthcare Corp.*, 607 F.3d 776, 783 (Fed. Cir. 2010) (“Because the claims perform the fundamental function of delineating the scope of the invention, the purpose of the definiteness requirement is to ensure that the claims delineate the scope of the invention using language that adequately notifies the public of the patentee’s right to exclude.”); *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996) (“words of the claims themselves ... define the scope of the patented invention”); *Phillips*, 415 F.3d at 1312 (“the Supreme Court made clear that the claims are of primary importance, in the effort to ascertain precisely what it is that is patented”) (internal quotation marks omitted); *Golight*, 355 F.3d at 1331.

Sometimes, the ordinary meaning of claim language as understood by a POSITA will be so apparent from the claim language itself that no further inquiry is needed. *Phillips*, 415 F.3d at 1314 (“the ordinary meaning of claim language as understood by a person of skill in the art may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words.”). Despite the ink spilled by

Maxell on this issue, the parties do not dispute the plain and ordinary meaning of the M<sup>1</sup> Terms, which plainly recite a logical impossibility that renders Claim 1 indefinite.

On the one hand, the M<sup>1</sup> Terms expressly state that Co is ***optional*** in M<sup>1</sup>. Indeed, Maxell does not dispute in its opening brief that at least when “looking at each part of the Cobalt Term in isolation ... the District Court’s description would not be wrong”: “The first part of the claim recites a *Markush* group where Co is not necessarily required to be in the claimed compound.” Appellant’s Br. (ECF 11) at 33. The practitioner of the ’035 Patent can select any one, two, or three of Co, Ni, and Mn. As Maxell concedes, “[i]f the claim ended there, ***M<sup>1</sup> could be any one of those metals alone, or any combination of those three metals.***” *Id.* (emphasis added); see Appx1753 (Fuller Dec.) ¶ 49 (“M<sup>1</sup> can be cobalt, or nickel, or manganese, or any combination thereof. It can, for example, be entirely nickel or a nickel-manganese alloy. In other words, the presence of cobalt is optional.”); see also *Ex parte Markush*, 1925 Dec. Comm’r Pat. 126, 127 (1924) (“where no generic expression exists by which a group of alternative elements can be claimed, applicants are permitted to recite the elements in the alternative”).

On the other hand, it is undisputed that the M<sup>1</sup> Terms *also* expressly require M<sup>1</sup> to contain at least 30% cobalt. Appellant’s Br. (ECF 11) at 33-34; Appx1753 (Fuller Dec. ¶ 50) (“But in the second part of the phrase, the patent indicates that cobalt must be between 30% and 100% of M<sup>1</sup>”).

It is impossible for cobalt to be simultaneously “optional” and “required” in M<sup>1</sup>. As Dr. Fuller (a POSITA) opined (*id.*):

This is an irreconcilable contradiction: if M<sup>1</sup> must contain 30%-100% cobalt, then it cannot be entirely nickel or manganese, despite the claim saying plainly that M<sup>1</sup> can be entirely nickel or manganese. Even multiple cobalt-containing alloys that are manifestly within the phrase “selected from Co, Ni and Mn”—for example, 20% Co, 40% Ni, and 40% Mn—are excluded by the later limitation that “the content of Co” in M<sup>1</sup> “is from 30% by mole to 100% by mole.”

The logical impossibility recited on the face of Claim 1’s M<sup>1</sup> Terms runs afoul of the definiteness requirement both subjectively and objectively.

***Subjectively***, the claim cannot possibly reflect what the applicants regarded as their invention. Even taking Maxell’s assertion at face value—that the applicants intended their invention to include the transition metal M<sup>1</sup> containing at least 30% cobalt—the first sentence in the M<sup>1</sup> Terms certainly claims a range of “selected” M<sup>1</sup> combinations

much broader than what the applicants had subjectively intended. And Maxell admits the *Markush* phrase in the M<sup>1</sup> Terms claims “any one of [Co, Ni, Mn] alone, or any combination of those three metals.” Appellant’s Br. (ECF 11) at 33.

This Court in *Allen Engineering* found a claim indefinite where “the invention set forth in a claim is not what the patentee regarded as his invention.” *Allen Eng’g Corp.*, 299 F.3d at 1349. There, the applicant drafted a claim that required the gearbox to pivot in the perpendicular direction while the intended invention disallows the gearbox to pivot in the perpendicular plane. *Id.* This type of disconnect is even clearer here because the logical impossibility is present on the face of the same claim.

**Objectively**, the claim cannot possibly define the metes and bounds of the invention because it contains an inherent logical contradiction and hence is “insolubly ambiguous.” A claim that is “insolubly ambiguous” is indefinite as a matter of law. *Halliburton Energy Servs.*, 514 F.3d at 1249. “Faced with these contradictions, a POSITA is unable to determine what, exactly, are the parameters of M<sup>1</sup>.” Appx1753 (Fuller Dec. ¶ 50). When a patentee fails in the basic task of explaining what is claimed, the Court should properly conclude that the claims are invalid under 35



U.S.C. § 112. *Halliburton Energy Servs.*, 514 F.3d at 1249.

Contrary to Maxell’s argument, this case is no different from *Multilayer*, where this Court held a dependent claim to be indefinite because it included an element that its independent claim excluded. *See Multilayer Stretch Cling Film Holdings, Inc. v. Berry Plastics Corp.*, 831 F.3d 1350, 1362 (Fed. Cir. 2016) (“Independent claim 1 excludes LDPE from the inner layers, while dependent claim 10 includes it. As such, claim 10 is inconsistent with claim 1 and, indeed, contradicts claim 1. A dependent claim that contradicts, rather than narrows, the claim from which it depends is invalid”). A facial contradiction means that a POSITA cannot determine the patent’s metes and bounds.

Both subjectively and objectively, Claim 1 is invalid.

### **III. Maxell’s Changing Position Regarding What the M<sup>1</sup> Terms Mean Highlights the Indefiniteness of the Underlying Claim**

Maxell’s inability to decide what its claim means is telling. From Maxell’s lips, either M<sup>1</sup> “constitutes a *Markush* group wherein M<sup>1</sup> represents Co, or Co and at least one transition metal element selected from the group consisting of Ni and Mn” (Appx0069) and the 30%-100% Co language “simply confirms that the presence of Co is required” (*id.*) **or** the *Markush* group M<sup>1</sup> “could be any one of those metals alone, or any

combination of those three metals” (Appellant’s Br. (ECF 11) at 33) but the 30-100% Co language “narrows the composition of M<sup>1</sup> from the broader first part.” *Id.* From the trial court to here, Maxell went from **(1)** arguing the first half of the M<sup>1</sup> Terms (the *Markush* language) requires Co, something the second half (the percentage of Co) merely confirms, to **(2)** treating the second half of the M<sup>1</sup> Terms (the percentage) as modifying the first (*Markush*) half, such that while the *Markush* grouping does not require Co the percentage clause does. To elaborate:

1. Maxell initially argued to the trial court that the *Markush* claim in the M<sup>1</sup> Terms ***requires*** the presence of cobalt and the later limitation of 30%-100% cobalt simply confirms it. As the district court put it,

In its response, Plaintiff contends that the first part of the claim “constitutes a *Markush* group wherein M<sup>1</sup> represents Co, or Co and at least one transition metal element selected from the group consisting of Ni and Mn.” ... Plaintiff contends that the second part of the claim “simply confirms that the presence of Co is required.”

Appx0069. The court rejected Maxell’s argument, noting that “rather than describe two options where Co is part of both options, the claim ... recites a *Markush* group where there are up to seven options (Co, Ni, Mn, Ni & Mn, Co & Mn, Co & Ni, Co & Ni & Mn) where Co is only present in four of the seven options.” Appx0071. This meant that “Plaintiff’s

assertion that Co is necessarily present in the claimed compound is incorrect, which means that aforementioned contradictions exists.” *Id.*

2. After the trial court rejected its initial argument during claim construction, Maxell took a different tack. In its motion for reconsideration, Maxell argued that:

The first part establishes the *potential* metals that can form M<sup>1</sup>: cobalt, nickel, and manganese. And if the claim ended there, M<sup>1</sup> could be any one of those three metals alone, or any combination of those three metals. But the claim does not end there; the second part of the term states that cobalt must be present in M<sup>1</sup> in an amount of 30% to 100% by mole. The language of the second part is mandatory, not optional. It clearly and unmistakably narrows the scope of the claim by requiring the presence of cobalt, such that M<sup>1</sup> can be cobalt alone, or a combination of cobalt with nickel and/or manganese, provided that the proportion of cobalt is at least 30%.

No. 6:21-cv-00347-ADA, ECF 79 at 5 (listed at Appx0095) (emphasis added)<sup>1</sup>; *see also* Appx2254-61 at 6:18-7:1 (“the first portion of the limitation starting with ‘M1 represents’ establishes the potential metals that can form M1, so that’s cobalt, nickel and manganese. And it’s the second portion of the term which states that cobalt must be present in M1 in an amount of 30 percent to 100 percent by mole. And that language

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<sup>1</sup> “Parts of the record may be relied on by the court or the parties even though not included in the appendix.” Fed. R. App. P. 30(a)(2).

in the second portion is mandatory. It clearly and unmistakably narrows the scope of the claim by requiring the presence of cobalt”). The trial court rejected this argument, too. Appx2271; Appx0018-20.

3. On appeal, Maxell repeats almost verbatim its second argument to the district court. But it never explains why it abandoned the initial claim construction position it took in the court below: the *Markush* group M<sup>1</sup>, instead of requiring Co, “could be any one of those metals alone, or any combination of those three metals.” Appellant’s Br. (ECF 11) at 33. And the 30%-100% cobalt limitation, instead of “simply confirm[ing] that the presence of Co is required [by the preceding *Markush* group],” now “narrows the composition of M<sup>1</sup> from the broader first part.” *Id.*

The inconsistency of Maxell’s arguments highlights the indefiniteness of the underlying claim.

#### **IV. Maxell Fails to “Reconcile” the Contradictory Requirements**

To walk back its admission that the *Markush* language covers “any combination of those three metals,” Maxell now argues that the *Markush* claim simply defines the “possible” or “potential” components of M<sup>1</sup> but does not require “every possible combination of those elements ... [to] be available.” Appellant’s Br. (ECF 11) at 15, 33, 36. According to Maxell,

“nothing in the first part of the term requires that M<sup>1</sup> can be just nickel, just manganese, or just combination of nickel and manganese, regardless of the remaining limitations.” *Id.* at 37; *see also id.* at 26 (“the first part of the term does not **require** that the elemental combination for M<sup>1</sup> must include combinations without cobalt”) (emphasis original). But it makes no sense to say that M<sup>1</sup> can be “selected from” Co, Ni, and Mn only to turn around and say that certain of those “selections” are not allowed after all. Arguing that the term does not require the *absence* of cobalt misses the point, which is that it does not require the *presence* of cobalt. The phrase “*at least one* transition metal element *selected from* Co, Ni and Mn” means exactly that: if the options are Co, Ni, and Mn, and M<sup>1</sup> has to be “selected from” “*at least one*” of those options, then by the dictates of English, M<sup>1</sup> can be Ni, or Mn, or a combination of Ni and Mn.

Maxell faults the district court for refusing to read the two parts of the M<sup>1</sup> Terms together. But the court below *did* read the two phrases together. And it found them contradictory, which is why it found the claim indefinite. The “remaining limitations” cannot change the phrase “at least one” to instead mean “cobalt alone or cobalt and at least one ...,” regardless of what Maxell’s inventors may have intended. *Vitronics*

*Corp.*, 90 F.3d at 1584 (“Nor may the inventor’s subjective intent as to claim scope, when unexpressed in the patent documents, have any effect. Such testimony cannot guide the court to a proper interpretation when the patent documents themselves do so clearly”).

## V. Intrinsic and Extrinsic Evidence Does Not Support Maxell

Nothing in the intrinsic or extrinsic record suggests that the inventors manifestly disclaimed or disavowed the full scope of the *Markush* group (Co, Ni, and/or Mn). This Court has long held that “claim terms take on their ordinary and accustomed meanings unless the patentee demonstrated an intent to deviate from the ordinary and accustomed meaning of a claim term by redefining the term or by characterizing the invention in the intrinsic record ***using words or expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope.***” *Teleflex, Inc.*, 299 F.3d at 1327 (emphasis added).

The use of extrinsic evidence is even more limited. Extrinsic evidence may be admissible to show, for example, that a particular claim term has a specialized meaning in the applicable art, but “extrinsic evidence ... may not be used to vary or contradict the claim language.”

*Vitronics Corp.*, 90 F.3d at 1584. “Extrinsic evidence should only be used by the court if the intrinsic evidence alone does not resolve any ambiguity in a disputed claim term.” *Wilson Sporting Goods Co. v. Hillerich & Bradsby Co.*, 2003 U.S. Dist. LEXIS 13900, at \*5 (N.D. Ill. Aug. 7, 2003) (citing *Vitronics Corp.*, 90 F.3d at 1583-84). Here, there is no ambiguity—just recriminations about the fact that the claim’s plain meaning extinguishes Maxell’s claim for damages.

**A. The court correctly rejected Maxell’s arguments—twice**

Maxell incorrectly asserts that “the District Court did not consider the ’035 Patent’s specification and prosecution history in its analysis of the Cobalt Term.” Appellant’s Br. (ECF 11) at 5. Not so. Maxell’s arguments regarding the ’035 Patent’s specification and prosecution history were presented to the district court twice, along with the testimony of its expert, Dr. Lucht. Appx0094 at ECF 52 (Maxell Claim Construction Br.) and ECF 79 (Maxell Mot. for Reconsideration); Appx2206-2221 at 56:13-61:17 (Maxell’s oral argument during *Markman* hearing that “ATL’s briefing also entirely ignores the specification and the prosecution history ...”); Appx2254-61 at 6:9-13:18 (Maxell’s oral argument regarding its Motion for Reconsideration requesting the trial

court to “reconsider its holding based on the claim language, the specification and the prosecution history”). And the district court rejected them twice. Appx0068-72 (*Markman* Order on Term #8); Appx0018-20 (Order Denying Reconsideration). The fact that the district court was not long detained by those arguments does not mean it overlooked them.

**B. The specification cannot rescue Maxell’s claim**

Maxell argues that the specification would guide a POSITA to the conclusion that M<sup>1</sup> “must” contain cobalt. Appellant’s Br. (ECF 11) at 15-16. “To avoid importing limitations from the specification into the claims, it is important to keep in mind that the purposes of the specification are to teach and enable those of skill in the art to make and use the invention and to provide a best mode for doing so.” *Phillips*, 415 F.3d at 1323.

The fact that the preferred embodiments in the specification contain cobalt is not nearly enough. To begin with, the parties do not dispute the plain and ordinary meaning of the M<sup>1</sup> Terms—which is, moreover, the claim construction *proposed by Maxell*. Appx2148 (“Maxell’s Proposed Construction: No construction necessary; Plain and ordinary meaning”).



Worse (for Maxell), the patent itself contradicts Maxell's argument. Maxell says that the court below did not give enough weight to the preferred embodiments in the '035 Patent, all of which include Co. Appellant's Br. (ECF 11) at 6, 15-16, 44. But the '035 Patent says expressly that "***the Examples do not limit the scope of the present invention.***" Appx0134 at 21:37-38 (emphasis added). Try as it might, Maxell cannot escape the plain language of its own patent.

Besides, while a court may look to the specification to *interpret* a claim, "limitations from the specification are not to be read into the claims ... for ***it is the claims that measure the invention.***" *Golight, Inc.*, 355 F.3d at 1331 (internal quotation marks and citations omitted; emphasis added). The specification is not a substitute for claim terms "particularly pointing out and distinctly claiming" the invention. 35 U.S.C. § 112 (b). The language of the specification is not a check or corrective on the plain meaning of the claim. "***Specifications teach. Claims claim.***" *SRI Int'l v. Matsushita Elec. Corp. of Am.*, 775 F.2d 1107, 1121 n.14 (Fed. Cir. 1985) (en banc) (emphasis added).

And so the mere fact that the *non-limiting* examples in the '035 Patent all contain Co would not inform a POSITA that M<sup>1</sup> *must* contain

Co despite the claim's statement that "M<sup>1</sup> represents *at least one* transition metal *element selected from* Co, Ni and Mn." *See Teleflex*, 299 F.3d at 1327 ("the number of embodiments disclosed in the specification is not determinative of the meaning of disputed claim terms"); *Halliburton Energy*, 514 F.3d at 1249 ("The common thread in all of these cases is that claims were held indefinite only where a person of ordinary skill in the art could not determine the bounds of the claims") (collecting cases).

**C. The prosecution history cannot rescue Maxell's claim**

Nor can Maxell overcome the facial contradiction in Claim 1 by pointing to language from the prosecution history. This Court "indulge[s] a 'heavy presumption' that a claim term carries its ordinary and customary meaning." *Golight, Inc.*, 355 F.3d at 1332. T]he prosecution history may not be used to infer the intentional narrowing of a claim absent the applicant's clear disavowal of claim coverage. To be given effect, such a disclaimer must be clear and unmistakable." *Sunrace Roots Enter. Co., Ltd. v. SRAM Corp.*, 336 F.3d 1298, 1306 (Fed Cir. 2003) (internal citations and quotation marks omitted).

If anything, the file history cuts against Maxell's position here.

Accepting Maxell's narrative, Maxell originally claimed M<sup>1</sup> to be "at least one transition metal element selected from Co, Ni and Mn." Appx0214. Then, Maxell told the PTO that "M<sup>1</sup> is ... CO." Appx0517. Still later, it restored the claim language that "M<sup>1</sup> represents at least one transition metal element selected from Co, Ni and Mn" and added the clause "wherein the content of Co in the transition metal M<sup>1</sup> is 30% by mole or more." Appx1272-73. At no point did anyone comment on the obvious contradiction the third amendment introduced. And while this may show a patentee trying to persuade the PTO to grant broader claims or to avoid denial based on prior art, it does not demonstrate that the inventor was, "clear[ly] and unmistakabl[y]," trying to disavow *both* lithium-containing transition metal oxides (LCTMOs) whose M<sup>1</sup> contained some combination of Mn and Ni but no Co *as well as* LCTMOs with less than 30% Co. *Saso Golf, Inc. v. Nike, Inc.*, 843 Fed. Appx. 291, 297 (Fed. Cir. 2021) (applying *Nautilus* and upholding district court's finding of indefiniteness due to lack of clarity in the term, and therefore "too indefinite to be valid").

Moreover, if a court considers a patent's file history, it should consider the *entire* file history of the patent family. "A statement made during prosecution of related patents may be properly considered in

construing a term common to those patents.” *Teva Pharms. USA, Inc. v. Sandoz, Inc.*, 789 F.3d 1335, 1343 (Fed. Cir. 2015). And Maxell never grapples with the fact that the file history of both the ’035 Patent specifically and the ’446 Patent family more broadly includes *multiple* claims where the patentee *does* unambiguously define an LCTMO as containing “Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn” (Appx0138, Cl.1) or Mg, or Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn.” Appx1526 (’019 Patent, Cl. 1); Appx1506 (’446 Patent, Cl. 1). Maxell never explains why the same inventors clearly expressed when *Mg* was required in  $M^2$  but left a POSITA to dig through the file history to determine that, in the ’035 Patent,  $M^1$  required Co, as well.

The fact that the applicants added the limitations previously deleted demonstrate the clear intent to claim the full scope allowed under the claim language. Maxell has not and cannot point to any statement that rises to the level of a clear disavowal of scope with respect the pending claim 1. *DeMarini Sports, Inc. v. Worth, Inc.*, 239 F.3d 1314, 1326-27 (Fed. Cir. 2001) (refusing to rely on ambiguity surrounding

examiner's silence or patentee's lack of argument during prosecution to construe claim term).

**D. Extrinsic evidence cannot rescue Maxell's claim**

Lastly, Maxell tries to counter the plain and ordinary meaning of the M<sup>1</sup> Terms by introducing a declaration from its expert witness, Dr. Lucht. Appx1762 (Lucht Dec. ¶ 72). But extrinsic evidence may only be used to aid the Court in understanding patent claims, and cannot be relied upon to justify any departure from or contradiction of the actual claim language employed by the applicants as in this case. *Vitronics Corp.*, 90 F.3d at 1584. Unsurprisingly, ATL's expert takes a different view of the meaning of the M<sup>1</sup> Terms. Appx0070-71; Appx1753 (Fuller Dec. ¶¶ 49-51). To the extent that these dueling expert opinions create an issue of fact, the Court reviews those "subsidiary factual determinations for clear error." *Eon Corp.*, 785 F.3d at 620. Maxell mentions but never applies this legal standard, *see* Appellant's Br. (ECF 11) at 29, and certainly does not demonstrate "that a mistake has been committed," *Flex-Rest*, 455 F.3d at 1357, merely because the trial court read the M<sup>1</sup> Terms in plain English.

## VI. Had Maxell Wanted to Draft A Claim That Required Cobalt, It Knew How To

At the risk of repetition, none of Maxell's arguments overcome the basic problem on the face of its claim. Compare how Claim 1 of the '035 Patent describes M<sup>1</sup> and M<sup>2</sup>:

- “M<sup>1</sup> represents at least one transition metal element selected from Co, Ni and Mn”
- “M<sup>2</sup> represents Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn”

Appx0138, Cl.1. If Maxell wanted to claim that M<sup>1</sup> requires Co and merely permits Ni and Mn, it knew exactly how to do so, because it expressly required Mg in the composition of M<sup>2</sup> ***in the very same claim.***

“Differences among claims can ... be a useful guide in understanding the meaning of particular claim terms.” *Phillips*, 415 F.3d at 1314. “[O]ther claims of the patent in question, both asserted and unasserted, can also be valuable sources of enlightenment as to the meaning of a claim term.”

*Id.* Federal Circuit “precedent instructs that different claim terms are presumed to have different meanings.” *Helmsderfer v. Bobrick Washroom Equip., Inc.*, 527 F.3d 1379, 1382 (Fed. Cir. 2008) (citations and quotation marks omitted). Thus, “at least one transition metal

element selected from ...” is presumed to mean something different from “[a transition metal element] **and** at least one metal element selected from ... .” “[T]he use of two terms in a claim **requires** that they connote different meanings.” *Applied Med. Res. Corp. v. U.S. Surgical Corp.*, 448 F.3d 1324, 1333 n.3 (Fed. Cir. 2006) (emphasis added).

For further support, the Court needs look no further than how the inventors described M<sup>1</sup> **and** M<sup>2</sup> in the '019 and '446 Patents. These patents share a similar (if not identical) specification and have an inventor (Fusaji Kita) in common. Appx1526 ('019 Patent, Cl. 1); Appx1506 ('446 Patent, Cl. 1). Claims from related patents are useful in determining the meaning of claim terms. *See, e.g., Omega Eng'g, Inc. v. Raytek Corp.*, 334 F.3d 1314, 1334 (Fed. Cir. 2003) (“we presume, unless otherwise compelled, that the same claim term in the same patent or related patents carries the same construed meaning”). In the '019 and '446 Patents, too, “M<sup>1</sup> represents at least one transition metal element selected from Co, Ni and Mn,” but “M<sup>2</sup> represents Mg, or Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn.” Appx1526 ('019 Patent, Cl. 1); Appx1506 ('446 Patent, Cl. 1). Either formulation informs a POSITA that Mg was required as part of

M<sup>2</sup>. Indeed, a comparison of the claims in the '446 patent family shows that the inventor was capable of making fine distinctions: the '035 Patent describes M<sup>2</sup> as representing “Mg and at least one metal element,” while the '019 and '446 Patents describe M<sup>2</sup> as representing “Mg, or Mg and at least one metal element”—indicating that M<sup>2</sup> must be a combination of Mg and another element in the '035 Patent but can be Mg alone in the '019 and '446 Patents. If the '035 Patent inventors wanted to ensure that Co was part of M<sup>1</sup>, they knew exactly how to say so.

## CONCLUSION

Courts construe claims with the goal of “elaborating the normally terse claim language in order to understand and explain, but not to change, the scope of the claims.” *Terlep v. Brinkmann Corp.*, 418 F.3d 1379, 1382 (Fed. Cir. 2005). Importantly, a court may not “re-write claims to preserve their validity” even if it is plain that the inventors did not mean what they wrote. For example, in *Allen Eng’g Corp.*, this Court addressed the issue of whether a court should redraft the claims to correct an obvious error. But the Court refused, because “[i]t is not our function to rewrite claims to preserve their validity.” 299 F.3d at 1349. “[I]t is of no moment that the contradiction is obvious: semantic



indefiniteness of claims ‘is not rendered unobjectionable merely because it *could* have been corrected.’” *Id.* (emphasis original).

This Court cannot ignore the plain meaning of the ’035 Patent’s claims in order to preserve Maxell’s lawsuit. ATL respectfully requests that the Court affirm the district court’s decision that the ’035 Patent is invalid for indefiniteness.

Dated: March 31, 2023

Respectfully submitted,

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## CERTIFICATE OF COMPLIANCE

This brief complies with the type-volume limitation of Federal Circuit Rule 32(b)(1). The brief contains 7,485 words, excluding the parts of the brief exempted by Federal Rule of Appellate Procedure 32(f) and Federal Circuit Rule 32(b)(2).

The brief complies with the typeface requirements of Federal Rule of Appellate Procedure 32(a)(5) and the type style requirements of Federal Rule of Appellate Procedure 32(a)(6). This brief has been prepared in a proportionally spaced typeface using Microsoft Word in Century Schoolbook 14-point font.

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## CERTIFICATE OF SERVICE

In accordance with Federal Rule of Appellate Procedure 25 and Federal Circuit Rule 25, I certify that on March 31, 2023, I caused a copy of the foregoing brief to be served electronically on all registered counsel through the Court's CM/ECF system.

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# **ADDENDUM**

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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AMPEREX TECHNOLOGY LIMITED

Petitioner

v.

MAXELL HOLDINGS, LTD,

Patent Owner

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Case: IPR2021-01441

U.S. Patent No. 9,077,035

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**PETITION FOR *INTER PARTES* REVIEW  
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104**

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**LIST OF EXHIBITS**

| <b>Exhibit</b> | <b>Short Name</b>          | <b>Description</b>  |
|----------------|----------------------------|---|
| Ex. 1001       | '035 Patent                | U.S. Patent No. 9,077,035   |
| Ex. 1002       | '035 File History          | File History of U.S. Patent No. 9,077,035   |
| Ex. 1003       | van Schalkwijk Declaration | Declaration of Dr. Walter van Schalkwijk under 37 C.F.R. § 1.68   |
| Ex. 1004       | van Schalkwijk CV          | <i>Curriculum Vitae</i> of Dr. Walter van Schalkwijk  |
| Ex. 1005       | Choi                       | U.S. Patent Application Publication No. 2006/0257745  |
| Ex. 1006       | Noh                        | U.S. Patent Application Publication No. 2004/0197667  |
| Ex. 1007       | Negishi                    | Japanese Patent Application Publication No. JP2000082466  |
| Ex. 1008       | Kita                       | Japanese Patent Application Publication No. JP2002270238  |
| Ex. 1009       | Ishikawa                   | U.S. Patent Application Publication No. 2004/0142245  |
| Ex. 1010       | van Schalkwijk             | “ <i>Advances in Lithium-Ion Batteries</i> ,” Walter A. van Schalkwijk and Bruno Scrosati, Eds., Kluwer Academic Publishers, 2002 |
| Ex. 1011       | Biensan                    | P. Biensan, B. Simon, J. P. Pérès, A. De Guibert, M. Broussely, J. M. Bodet, and F. Perton, J. Power Sources, 81–82, 906 (1999)   |
| Ex. 1012       | Richard                    | M. N. Richard and J. R. Dahn, J. Power Sources, 79, 135 (1999)  |
| Ex. 1013       | Spotnitz                   | R. Spotnitz and J. Franklin, J. Power Sources, 113, 81 (2003)   |

| <b>Exhibit</b> | <b>Short Name</b>        | <b>Description</b>  |
|----------------|--------------------------|---|
| Ex. 1014       | Baba                     | Y. Baba, S. Okada, and J. I. Yamaki, Solid State Ionics, 148, 311 (2002)  |
| Ex. 1015       | Abraham                  | D. P. Abraham, E. P. Roth, R. Kostecki, K. McCarthy, S. MacLaren, and D. H. Doughty, J. Power Sources, 161, 648 (2006)  |
| Ex. 1016       | MacNeil                  | D. D. MacNeil, J. Electrochem. Soc., 146, 3596-3602 (1999)  |
| Ex. 1017       | Sato                     | U.S. Patent Application Publication No. 2005/0266315  |
| Ex. 1018       | Watanabe                 | U.S. Patent Application Publication No. 2006/0194109  |
| Ex. 1019       | Belharouak               | Belharouak et al., Electrochemistry Communications 8, 329–335 (2006)  |
| Ex. 1020       | Dahn                     | Dahn, et al., Solid State Ionics 69, 265-70 (1994)  |
| Ex. 1021       | Ohzuku                   | Ohzuku, et al., Electrochimica Acta, 38, 1159-1167 (1993)   |
| Ex. 1022       | Tukamoto                 | Tukamoto et al., J. Electrochem. Soc. 144 pp 3164-3168 (1997)   |
| Ex. 1023       | McMillan                 | McMillan et al., J. Power Sources, 81-82, 20-26 (1999)  |
| Ex. 1024       | Madhavi                  | Madhavi et al., Solid State Ionics, 152-153, 199-205 (2002)   |
| Ex. 1025       | Myung                    | Myung et al., J. Power Sources, 146, 645-49 (2005)  |
| Ex. 1026       | Infringement Contentions | Maxell Infringement Contentions, <i>Maxell Holdings, Ltd. v. Amperex Tech. Ltd.</i> , No. 6:21-cv-00347-ADA (W.D. Tex.) |

| <b>Exhibit</b> | <b>Short Name</b>                    | <b>Description</b>                                      |
|----------------|--------------------------------------|---|
| Ex. 1027       | Standing Order                       | August 18, 2021 Standing Order                          |
| Ex. 1028       | Order of<br>Governing<br>Proceedings | June 24, 2021 Order of Governing<br>Proceedings         |
| Ex. 1029       | Awano                                | U.S. Patent Application Publication No.<br>2005/0271576 |

Amperex Technology Limited (“Petitioner”) petitions for *Inter Partes* Review (“IPR”) under 35 U.S.C. §§311–319 and 37 C.F.R. §42 of Claims 1-5 (“the challenged claims”) of U.S. Patent No. 9,077,035 (“the ’035 Patent”).

**I. GROUNDS FOR STANDING**

Petitioner certifies that the ’035 Patent is available for IPR and that Petitioner is not barred or estopped.

**II. PAYMENT OF FEES**

Petitioner authorizes Account No. 16-0605 to be charged.

**III. OVERVIEW OF CHALLENGES**

Pursuant to Rules 42.22(a)(1) and 42.104(b)(1)–(2), Petitioner requests cancellation of the challenged claims in view of the grounds herein. This petition provides details on claim construction and the cited prior art. Additional support is provided in Ex. 1003–Declaration of Walter van Schalkwijk (“van Schalkwijk”).

¶10 *et seq.*

**Ground 1:** Claims 1–11 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Choi and Noh.

**Ground 2:** Claims 1–6, 9–11 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Negishi and Kita.

**Ground 3:** Claim 8 is unpatentable under pre-AIA 35 U.S.C. §103(a) over Negishi, Kita, and Ishikawa.

**Ground 4:** Claim 7 is unpatentable under pre-AIA 35 U.S.C. §103(a) over Negishi, Kita, and Awano.

#### **IV. BACKGROUND**

##### **A. The '035 Patent**

The '035 Patent describes a nonaqueous secondary battery having a positive electrode active material including at least two lithium-containing transition metal oxides. Ex. 1001, 2:54-67; Ex. 1003, ¶¶80-102.

##### **B. '035 Patent Prosecution History**

U.S. Patent Application No. 11/723,350 (“the '350 Application”) was filed on March 16, 2007. Ex. 1002, 4; Ex. 1003, ¶105. After extensive prosecution, Applicant amended the claims to require Mg and another element rather than a single element to overcome the rejections based on JP 2005-302507 (“Oda”), which Applicant characterized as exemplifying Al alone. Ex. 1002, 1071, 1083; Ex. 1003, ¶¶106-119. After further prosecution, Applicant amended the claims to require a Co content of 30% or more and that M<sup>1</sup> is only Co. Ex. 1002, 1134-1138; Ex. 1003, ¶¶120-123. Applicant argued that Oda does not teach the claimed Co content. Ex. 1002, 1142; Ex. 1003, ¶123.

A Notice of Allowance was mailed on March 20, 2015. Ex. 1002, 1182; Ex. 1003, ¶¶124-126.



### **C. Priority Date**

The earliest possible priority date of the '035 Patent is March 20, 2006, the date the '040 JP Application was filed. Ex. 1003, ¶104. Petitioner reserves the right to address priority at a later date should Patent Owner assert that each application in its priority chain meets the requirements of 35 U.S.C. §120. *See MaxLite, Inc. v. Jiaxing Super Lighting Elec. Appliance Co.*, No. IPR2020-00208, Paper 14 at 8 (PTAB June 1, 2021).

The critical date for determining the §102(b) statutory bar for the '035 Patent is March 16, 2006, one year prior to the date the U.S. parent application was filed. *See* 35 U.S.C. §102(b); *see also* 35 U.S.C. §119(a); MPEP §§ 706.02(VI), 2133.02(II), 2139.01; *see also Japan Cash Mach. Co. v. Mei, Inc.*, No. 2:05-cv-01433-RCJ-RJJ, 2008 U.S. Dist. LEXIS 138439, at \*51 (D. Nev. Oct. 21, 2008); *LG Elecs., Inc. v. Core Wireless S.A.R.L.*, No. IPR2015-01988, Paper 31 at 26–28 (PTAB Mar. 16, 2017).

### **D. Claim Construction (37 C.F.R. §42.104(b)(3))**

Claim terms are interpreted with the ordinary and customary meaning as understood by a person of ordinary skill in the art (“POSITA”) under *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005).

The challenged claims of the '035 Patent do not include any terms that require specific construction. For purposes of this IPR, each challenged claim

includes terms that a POSITA would understand according to their plain and ordinary meaning.<sup>1</sup> Ex. 1003, ¶128.

**V. PRIOR ART REFERENCES**

**A. US2006/0257745 (“Choi”)**

Choi (Ex. 1005) was filed on February 15, 2006 and published on November 16, 2006. Choi is prior art under at least pre-AIA 35 U.S.C. §102(e).

**B. US2004/0197667 (“Noh”)**

Noh (Ex. 1006) was filed on September 3, 2003 and published on October 7, 2004. Noh is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b).

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<sup>1</sup> Patent Owner broadly interprets the term “at least two lithium-containing transition metal oxides” to include multiple particle sizes of a single lithium-containing transition metal oxide where only one peak has been separated into multiple peaks on a particle size distribution diagram, as often occurs with conventional peak-separating methods. Ex. 1026, 7-9. Petitioner more narrowly interprets the claims to require a mixture of two separate lithium-containing transition metal oxides.

**C. JP2000082466 (“Negishi”)**

Negishi (Ex. 1007) published on March 21, 2000. Negishi is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b). Ex. 1007.<sup>2</sup>

**D. JP2002270238 (“Kita”)**

Kita (Ex. 1008) published on September 20, 2002. Kita is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b).

**E. US2004/0142245 (“Ishikawa”)**

Ishikawa (Ex. 1009) was published on July 22, 2004. Ishikawa is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b).

**F. US2005/0271576 (“Awano”)**

Awano (Ex. 1029) was published on December 8, 2005. Awano is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b)

**VI. LEVEL OF ORDINARY SKILL IN THE ART**

A POSITA would have had at least a bachelor’s degree in chemistry, chemical engineering, or materials science and five or more years of experience in the field of batteries and battery materials. Ex. 1003, ¶11.

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<sup>2</sup> Exs. 1007 and 1008 are accompanied by a certified translation and the original document in the same exhibit. 37 C.F.R. §42.63(b); 35 U.S.C. §312(a)(5); *Ninebot (Tianjin) Tech. Co. v. Inventist, Inc.*, No. IPR2018-00134, Paper 11 at 10-11 (PTAB Apr. 23, 2018).

## **VII. THE CHALLENGED CLAIMS ARE UNPATENTABLE**

At the time of the possible priority date, improving battery capacity drove lithium ion battery development, as applications for these batteries competed to achieve longer runtimes for their products. Ex. 1010, 267; Ex. 1003, ¶170. Increasing capacity often came at the expense of thermal stability. Ex. 1022; Ex. 1003, ¶45.

Positive electrode formulations (e.g.,  $\text{LiCo}_{1-x-y}\text{M}_1\text{M}_2\text{O}_2$ ) were used in this technology. Ex. 1003, ¶42. It was well-known to substitute other atoms and/or otherwise alter the stoichiometry to impart desirable characteristics to the cathode and enhance the cell or battery performance (e.g., capacity and/or thermal stability). Ex. 1003, ¶43.

The '035 Patent claims a battery including these components. Ex. 1003, ¶82. During prosecution, the Applicant amended the claims to recite a specific combination of elements in its two formulations and to require Mg and a particular Co concentration. Ex. 1002, 1070-1071, 1083, 1112-1113, 1122. The resulting claims recited well-known elements for substituting into the lithium-containing transition metal oxide formulation. Ex. 1003, ¶43.

**A. GROUND 1: THE COMBINATION OF CHOI AND NOH  
RENDERS OBVIOUS CLAIMS 1-11**

***1. Overview of Ground 1***

**i. Choi and Noh**

Choi teaches a “lithium secondary battery” having at least two positive electrode active materials with different average particle sizes. Ex. 1005, [0002], [0010]-[0011], [0048]; Ex. 1003, ¶¶129-133. Choi also discloses a negative electrode, and a nonaqueous electrolyte including an organic solvent. Ex. 1005, [0052], [0061]; Ex. 1003, ¶¶134-153.

Noh discloses a lithium secondary battery having a positive electrode including a lithium-containing transition metal oxide. Ex. 1006, [0032], [0035], [0058], [0065]; Ex. 1003, ¶¶136-138. Noh discloses the incorporation of a fluorine-containing organic solvent into its electrolyte. Ex. 1006, [0037], [0039]; Ex. 1003, ¶¶139-141.

**ii. Motivation to Combine**

Choi discloses a nonaqueous lithium secondary battery including a nonaqueous electrolyte including an organic solvent. Ex. 1005, [0002], [0010]-[0011], [0048], [0052], [0061]; Ex. 1003, ¶143.

While Choi does not explicitly teach that its electrolyte contains a fluorine-containing organic solvent, Choi discloses that one goal of its batteries is improving thermal stability and discharge characteristics. Ex. 1005, [0002]; Ex.

1003, ¶144. A POSITA would have understood that thermal stability is critical to battery safety. Ex. 1003, ¶144. Thus, a POSITA would have looked to Noh's inclusion of a fluorine-containing organic solvent in its electrolyte to improve thermal stability. Ex. 1003, ¶¶145-149. Noh, disclosing the same types of cathode and anode materials as Choi, identifies limitations of these materials, including gas generation at high temperatures, which may result in thermal runaway. Ex. 1005, [0010]-[0011]; Ex. 1006, [0035]-[0036]; Ex. 1003, ¶¶150-151.

Both Noh and Choi include a nonaqueous organic solvent in their electrolytes. Ex. 1005, [0061]; Ex. 1006, [0045]; Ex. 1003, ¶150. Noh further discloses that use of a fluorine-containing carbonate-based additive compound in its electrolyte improves thermal stability and discharge characteristics. Ex. 1006, [0033], [0037]-[0038]; Ex. 1003, ¶149.

Lithium-ion chemistry was predictable at the time of Choi, Noh, and the '035 Patent. Ex. 1003, ¶40. Choi and Noh disclose similar cathode, anode, and electrolyte materials, and are directed to improving thermal stability and discharge characteristics in their respective batteries. Ex. 1005, [0002], [0010]-[0011], [0061], [0095]; Ex. 1006, [0016], [0035]-[0036], [0038], [0064]; Ex. 1003, ¶150. Additionally, Noh explains that lithium secondary batteries stand to benefit from improved thermal stability and discharge characteristics, and that its

fluorine-containing carbonate-based additive compound improves both in its battery. Ex. 1006, [0033], [0037]-[0038]; Ex. 1003, ¶¶145-149. Thus, a POSITA would have had a reasonable expectation of success combining Choi and Noh. Ex. 1003, ¶¶150-151.

A POSITA would have been motivated to combine Choi and Noh because doing so would result in a simple substitution of the electrolyte of Choi with that of Noh. Ex. 1003, ¶¶149-150. The only difference between Choi and the '035 Patent is the inclusion of fluorine-based electrolyte additives. Ex. 1003, ¶150. Noh discloses the same electrolyte as Choi with the addition of additives to increase thermal stability and improve discharge characteristics. Ex. 1005, [0061]; Ex. 1006, [0033], [0037]-[0038], [0056], [0064]; Ex. 1003, ¶¶143-150. Thus, a POSITA would have understood that the electrolyte of Choi could simply be substituted with the electrolyte of Noh, and the results would have been predictable. Ex. 1003, ¶150.

***2. Claim 1: [1.Pre] A nonaqueous secondary battery comprising:***

To the extent the preamble is limiting, Choi and Noh disclose a nonaqueous secondary battery. Ex. 1003, ¶152.

Choi teaches a lithium-ion battery. Ex. 1005, [0062]; Ex. 1003, ¶¶153-157; *see also* Ex. 1026, 1-2 (asserting that a “lithium-ion battery” is a nonaqueous secondary battery). A POSITA would have understood that Choi’s lithium-ion

battery is nonaqueous. Ex. 1003, ¶¶153-157. Indeed, Choi discloses using a nonaqueous organic electrolyte solvent. Ex. 1005, [0061]; Ex. 1003, ¶156.

Noh explicitly discloses “a non-aqueous Li-ion cell” and “a lithium secondary battery.” Ex. 1006, [0032], [0058]; Ex. 1003, ¶158.

**3. Claim 1: [1.A] a positive electrode having a positive electrode mixture layer,**

Choi discloses a “cathode,” and the formation of the electrode using a positive electrode mixture layer. Ex. 1005, [0009], [0048]; Ex. 1003, ¶159.

Noh discloses a “positive electrode” and the formation of the positive electrode using a positive electrode mixture layer. Ex. 1006, [0032], [0065]; Ex. 1003, ¶160.

**4. Claim 1: [1.B] a negative electrode, and**

Choi discloses the formation of an “anode.” Ex. 1005, [0052]; Ex. 1003, ¶161. Noh discloses a “negative electrode.” Ex. 1006, [0032]; Ex. 1003, ¶162.

**5. Claim 1: [1.C] a nonaqueous electrolyte,**

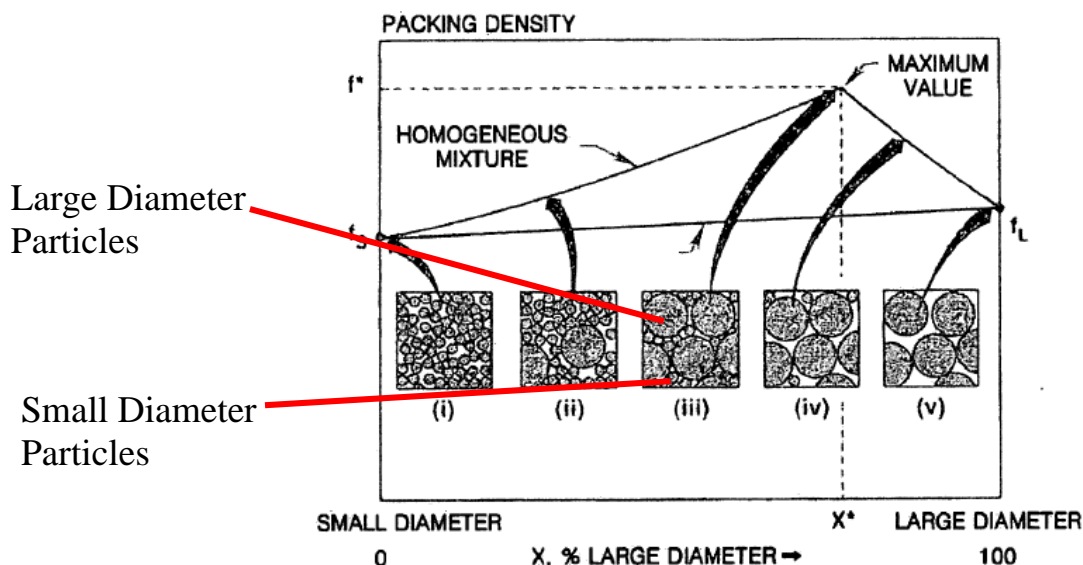
Choi describes nonaqueous organic electrolyte solvents. *See supra* §VII.A.2; Ex. 1005, [0061]; Ex. 1003, ¶163.

Noh discloses nonaqueous organic electrolyte solvents. Ex. 1006, [0045]; Ex. 1003, ¶164.



**6. Claim 1: [1.D] wherein the positive electrode comprises, as active materials, at least two lithium-containing transition metal oxides having different average particle sizes, and**

Choi describes “at least one *large diameter active material* selected from the group consisting of compounds represented by formulas 1 and 2, and at least one *small diameter active material* selected from the group consisting of... compounds represented by formulas 2, 3, 4....” Ex. 1005, [0010]-[0011] (emphasis added). Choi Formulas 1 and 2 represent a lithium-containing transition metal oxide. *Id.*; Ex. 1003, ¶165. Choi teaches “ratios of the average particle diameter of the large diameter material to the average particle diameter of the small diameter material ranging from 6:1 to 100:1 and a weight ratio of the particles ranging from 60:40 to 90:10.” Ex. 1005, [0034], [0086], FIG. 2; Ex. 1003, ¶166.



7. **Claim 1: [1.E] the lithium-containing transition metal oxide having the smallest average particle size is a lithium-containing transition metal oxide represented by the formula (1):  $\text{Li}_x\text{M}^1_y\text{M}^2_z\text{M}^3_v\text{O}_2$  (1) wherein  $\text{M}^1$  represents at least one transition metal element selected from Co, Ni and Mn,  $\text{M}^2$  represents Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn,  $\text{M}^3$  represents at least one element selected from the group consisting of Na, K, Rb, Be, Ca, Sr, Ba, Sc, Y, La, Hf, V, Ta, Cr, Mo, W, Tc, Re, Fe, Ru, Rh, Cu, Ag, Au, B, Ca, In, Si, P and Bi, and x, y, z and v are numbers satisfying the equations respectively:  $0.97 \leq x < 1.02$ ,  $0.8 \leq y < 1.02$ ,  $0.002 \leq z \leq 0.05$ , and  $0 \leq v \leq 0.05$ , and**

Choi teaches:

at least *one small diameter active material selected from the group consisting of...compounds represented by formulas 2, 3, 4....*



In Formulas 1 through 4,  $0.90 \leq x \leq 1.1$ ,  $0 \leq y \leq 0.9$ ,  $0 \leq z \leq 0.5$ ,  $0 \leq \alpha \leq 2$ , M is selected from the group consisting of Al, Ni, Mn, Cr, Fe, Mg, Sr, V, rare earth elements and mixtures thereof, and X is selected from the group consisting of O, F, S and P.

Ex. 1005, [0010]-[0011] (emphasis added). A POSITA would have selected Choi's Formula 2 to correspond to formula (1) recited in limitation 1.E. Ex. 1003, ¶¶167-172.

Lithium Content

Choi discloses the value of “x” in  $\text{Li}_x$  in Formula 2 as “ $0.90 \leq x \leq 1.1$ ,” while limitation 1.E claims the value of “x” in  $\text{Li}_x$  as “ $0.97 \leq x < 1.02$ .” Ex. 1005, [0010]-[0011]; Ex. 1003, ¶172. A larger range taught by a prior art reference (e.g., “ $0.90 \leq x \leq 1.1$ ”) that encompasses or subsumes a smaller claimed range (e.g., “ $0.97 \leq x < 1.02$ ”) is sufficient to establish a *prima facie* case of obviousness. *In re Peterson*, 315 F.3d 1325, 1330 (Fed. Cir. 2003); *In re Harris*, 409 F.3d 1339 (Fed. Cir. 2005); *E.I. du Pont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018); Ex. 1003, ¶174.

A POSITA would have been motivated to select a value of x approximately equal to 1, and the '035 Patent confirms this understanding. Ex. 1003, ¶174; Ex. 1001, 7:4-10. In a non-limiting example, Choi discloses  $\text{LiCo}_{0.95}\text{Mg}_{0.05}\text{O}_2$ , which has a value of x equal to 1. Ex. 1005, [0041].

M<sup>1</sup>

Choi’s Formula 2 is “ $\text{Li}_x\text{Co}_{1-y-z}\text{Ni}_y\text{M}_z\text{O}_{2-\alpha}\text{X}_\alpha$ ,” where M<sup>1</sup> recited in limitation 1.E is equivalent to Co and Ni in Formula 2. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶175-176. Alternatively, because Choi teaches “ $0 \leq y \leq 0.9$ ” where “y” can be 0, M<sup>1</sup> recited in limitation 1.E would also be equivalent to only Co in Formula 2. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶176.

Limitation 1.E recites the value for  $M^1$  is “y,” where “y” is “ $0.8 \leq y < 1.02$ .” Based on Choi’s disclosure of “ $0 \leq y \leq 0.9$ ,  $0 \leq z \leq 0.5$ ” and that the value of Co is equal to “ $1-y-z$ ,” Choi discloses a Co value ranging from 0 to 1 and a Ni value equal to “y,” which is “ $0 \leq y \leq 0.9$ .” Ex. 1005, [0010]-[0011]; Ex. 1003, ¶176. Because Choi provides that the value of Co is dependent upon the value of Ni, the range of values for Co and Ni combined in Choi overlaps with the range of values for “y” recited in limitation 1.E. Ex. 1003, ¶176. In a non-limiting example, Choi discloses  $\text{LiCo}_{0.95}\text{Mg}_{0.05}\text{O}_2$ , which has a value of Co of 0.95. Ex. 1005, [0041].

A range taught by a prior art reference that overlaps a claimed range is sufficient to establish a *prima facie* case of obviousness. *Peterson*, 315 F.3d at 1330; *Harris*, 409 F.3d 1339; *Synvina*, 904 F.3d at 1006; Ex. 1003, ¶177. Further, Co concentration is a result effective variable because increasing Co concentration is known to increase thermal stability. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295-96 (Fed. Cir. 2012); Ex. 1019; Ex. 1020; Ex. 1021; Ex. 1003, ¶177. Thus, the optimum range of Co concentration could have been discovered by routine experimentation. *Id.* Indeed, a POSITA would have been

motivated to select as high a Co concentration as reasonably possible to optimize thermal stability and capacity of the battery. Ex. 1017, [0031]<sup>3</sup>; Ex. 1003, ¶177.

M<sup>2</sup>

Choi's Formula 2 is " $\text{Li}_x\text{Co}_{1-y-z}\text{Ni}_y\text{M}_z\text{O}_{2-\alpha}\text{X}_\alpha$ ," where M<sup>2</sup> recited in limitation 1.E is equivalent to "M" in Formula 2. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶178. Indeed, Choi discloses that "M is selected from the group consisting of Al, Ni, Mn, Cr, Fe, Mg, Sr, V, rare earth elements and mixtures thereof." Ex. 1005, [0010]-[0011].

A POSITA would have been motivated to select Mg and Al from the elements taught by Choi. Ex. 1003, ¶¶178-180. Indeed, each doping element (e.g., Mg, Al, etc.) plays a different role in modifying the material properties of the host material (e.g., lithium cobalt oxide), with Mg enhancing the material's electronic conductivity, and Al providing structural enhancement to the cathode. Ex. 1024; Ex. 1003, ¶179. Further, Mg and Al are the smallest elements Choi

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<sup>3</sup> Publication No. 2005/0266315 by Sato confirms what a POSITA would have known—as Co content increases, so does the charge/discharge efficiency and discharge voltage. Ex. 1017, [0031]. To be clear, this ground is obviousness in view of Choi and Noh. Sato does not form part of the combination/modification. Rather, Sato is provided to establish the POSITA's base knowledge.

teaches, meaning that that Mg and Al are less likely to disrupt the structure of the positive electrode active material. Ex. 1024; Ex. 1003, ¶180. Moreover, Mg and Al have singular oxidation states of +2 and +3, respectively, allowing these atoms to reside in the structure of the cathode material without being oxidized or reduced. Ex. 1024; Ex. 1003, ¶180.

Limitation 1.E also requires that the value for  $M^2$  is “z,” where “z” is “ $0.002 \leq z \leq 0.05$ .” Choi teaches that the value for M in Formula 2 is “z,” where “z” is “ $0 \leq z \leq 0.5$ .” Ex. 1005, [0010]-[0011]. While Choi discloses the possibility of excluding “M” from Formula 2, a POSITA would have understood that the inclusion of Mg and Al would provide certain benefits and enhancements to the cathode. Ex. 1003, ¶181.

A larger range taught by a prior art reference (e.g., “ $0 \leq z \leq 0.5$ ”) that encompasses or subsumes a smaller claimed range (e.g., “ $0.002 \leq z \leq 0.05$ ”) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7 (“Lithium Content”); Ex. 1003, ¶182. Further, Mg and Al concentration is a result effective variable because increasing Mg and Al concentration is known to increase the stability of the cathode structure, albeit at the expense of transition metal content. *Applied Materials*, 692 F.3d at 1295-96; Ex. 1003, ¶182. Thus, the optimum range of Mg and Al concentration could have been discovered by routine experimentation. *Id.* Indeed, a POSITA would have been motivated to

use as small an amount of Mg and Al as possible necessary to stabilize the structure, as a POSITA would have understood that Mg and Al do not participate in the electrochemical reaction and are present at the expense of Co and/or Ni, which are electrochemically active and contribute to the battery's capacity. Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>4</sup>; Ex. 1022; Ex. 1003, ¶182.

$M^3$

Formula 2 of Choi is " $\text{Li}_x\text{Co}_{1-y-z}\text{Ni}_y\text{M}_z\text{O}_{2-a}\text{X}_a$ ," where " $M^3$ " recited in limitation 1.E is equivalent to "X" in Formula 2. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶183. Choi teaches that "X is selected from the group consisting of O, F, S and P." Ex. 1005, [0010]-[0011]. Thus, Choi teaches "P" as  $M^3$ . Ex. 1003, ¶183.

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<sup>4</sup> Sato and Publication No. 2006/0194109 by Watanabe confirm what a POSITA would have known—as metal additive (e.g., Mg and Al) content increases beyond a threshold (e.g., 0.03), initial capacity decreases. Ex. 1017, [0029]; Ex. 1018, [0036]. Further, Sato confirms that using both Mg and Al provides additional benefits over using one element alone. Ex. 1017, [0096], Table 2 (providing example with  $\text{Li}_{1.00}\text{CoAl}_{0.015}\text{Mg}_{0.015}\text{O}_2$  having improved efficiency and capacity retention). To be clear, this ground is obviousness in view of Choi and Noh. Sato and Watanabe do not form part of the combination/modification. Rather, Sato and Watanabe are provided to establish the POSITA's base knowledge.

Limitation 1.E recites that “v” is “ $0 \leq v \leq 0.05$ ,” and the ’035 Patent further discloses that formula (1) recited in limitation 1.E “may contain no  $M^3$ .” Ex. 1001, 9:24; *see also* Ex. 1026, 7 (asserting that  $M^3$  is “not present”). Choi teaches that the value of “ $\alpha$ ” is “ $0 \leq \alpha \leq 2$ ” where  $\alpha$  can be 0. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶184. A POSITA would have known that by setting “ $\alpha$ ” at 0, Formula 2 would provide an oxide  $O_2$  because the value of oxygen in Formula 2 (“ $O_{2-\alpha}$ ”) depends upon the value of “ $\alpha$ ,” and a POSITA would have known that an oxide would render the positive electrode active material easier to synthesize. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶184.

#### Oxygen Content

Formula 2 of Choi teaches “ $O_2$ ” when the value of “ $\alpha$ ” is set at 0. Ex. 1003, ¶¶185-186.

#### **8. Claim 1: [1.F] has an average particle size from 2 $\mu m$ to 10 $\mu m$ , and**

Choi discloses that “[t]he average particle diameter D50 of the small diameter active material may range from about 0.05 to about 5  $\mu m$ .” Ex. 1005, [0018], [0047]; Ex. 1003, ¶187. In a non-limiting example, Choi discloses that the average particle diameter of the small diameter active material is 2  $\mu m$ . Ex. 1005, [0065].

A range taught by a prior art reference that overlaps a claimed range is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex.



1003, ¶188. Further, particle size is a result effective variable because particle size is known to be inversely proportional to specific surface area per gram, with increased specific surface area enabling the active material to charge/discharge to a higher power. *Applied Materials*, 692 F.3d at 1295-96; Ex. 1016; Ex. 1003, ¶188. Thus, the optimum particle size range could have been discovered by routine experimentation. *Id.* Indeed, a POSITA would have been motivated to select a smaller average particle size to increase power. Ex. 1003, ¶188.

**9. Claim 1: [1.G] and the lithium-containing transition metal oxide having the largest average particle size is a lithium-containing transition metal oxide represented by the formula (2):  $Li_aM^1_bM^2_cM^3_dO_2$  (2) wherein  $M^1$ ,  $M^2$  and  $M^3$  are the same as defined in the formula (1), and  $a$ ,  $b$ ,  $c$  and  $d$  are numbers satisfying the equations respectively:  $0.97 \leq a < 1.02$ ,  $0.8 \leq b < 1.02$ ,  $0.0002 \leq c \leq 0.02$ , and  $0 \leq d \leq 0.02$ , and**

Choi teaches "at least one *large diameter active material selected from the group consisting of compounds represented by formulas 1 and 2.*" Ex. 1005, [0010]-[0011]. A POSITA would have understood that the "at least one large-diameter active material selected from the group consisting of compounds of formulas 1 and 2" correlates to "the lithium-containing transition metal oxide having the largest average particle size is a lithium-containing transition metal oxide represented by the formula (2)" recited in limitation 1.G. Ex. 1003, ¶¶189-190. That is, it would have been clear to a POSITA that both Formula 1 and

Formula 2 of Choi disclose the lithium-containing transition metal oxide represented by the formula (2) recited in limitation 1.G. Ex. 1003, ¶¶189-190.

Choi Formula 1 - Lithium Content

Presented with Choi Formula 1, a POSITA would have recognized that Choi discloses the value of lithium recited in limitation 1.G. Ex. 1003, ¶191. Indeed, Choi teaches that the value of “x” in  $\text{Li}_x$  is “ $0.90 \leq x \leq 1.1$ ,” while the value of “a” in  $\text{Li}_a$  recited in limitation 1.G is “ $0.97 \leq a < 1.02$ .” Ex. 1005, [0010]-[0011]. A larger range taught by a prior art reference (e.g., “ $0.90 \leq x \leq 1.1$ ”) that encompasses or subsumes a smaller claimed range (e.g., “ $0.97 \leq a < 1.02$ ”) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶192. Indeed, a POSITA would have been motivated to select a value of x in Choi approximately equal to 1, and the '035 Patent confirms this understanding. Ex. 1003, ¶192; Ex. 1001, 7:4-10. In a non-limiting example, Choi discloses  $\text{LiNi}_{0.9}\text{Co}_{0.1}\text{O}_2$ , which has a value of x equal to 1. Ex. 1005, [0039].

Choi Formula 1 –  $M^I$

Formula 1 of Choi also discloses “ $M^I_b$ ” recited in limitation 1.G. Specifically, Formula 1 of Choi is “ $\text{Li}_x\text{Co}_{1-y}\text{M}_y\text{O}_{2-\alpha}\text{X}_\alpha$ ,” where  $M^I$  recited in limitation 1.G is equivalent to Co in Formula 1. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶193-194. Alternatively, because Choi teaches that “M is selected from

the group consisting of Al, Ni, Mn, Cr, Fe, Mg, Sr, V, rare earth elements and mixtures thereof,” Formula 1 of Choi also contemplates the inclusion of Ni and/or Mn along with Co. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶194.

Limitation 1.G also requires that the value for  $M^1$  is “b,” where “b” is “ $0.8 \leq b < 1.02$ .” Ex. 1003, ¶195. Because the value of Co is equal to “1-y,” and Choi teaches that “ $0 \leq y \leq 0.9$ ,” Choi discloses a value of Co ranging from 0.1 to 1. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶195. Accordingly, the range of values for Co in Choi overlaps with the range of values for “b” recited in limitation 1.G. *Id.* In a non-limiting example, Choi discloses  $\text{LiNi}_{0.9}\text{Co}_{0.1}\text{O}_2$ , which has a value of y equal to 0.9, such that the total transition metal content is 1, which falls within the range “ $0.8 \leq b < 1.02$ ” recited in limitation 1.G. Ex. 1005, [0039].

A range taught by a prior art reference that overlaps a claimed range is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶196. Further, Co concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.A.7; Ex. 1017, [0031]<sup>5</sup>; Ex. 1019; Ex. 1020; Ex. 1021; Ex. 1003, ¶196.

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<sup>5</sup> *See supra* n3.

Choi Formula 1 – M<sup>2</sup>

Formula 1 of Choi is “Li<sub>x</sub>Co<sub>1-y</sub>M<sub>y</sub>O<sub>2-α</sub>X<sub>α</sub>,” where M<sup>2</sup> recited in limitation 2.A is equivalent to “M” in Formula 1. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶197. Choi further discloses that “M is selected from the group consisting of Al, Ni, Mn, Cr, Fe, Mg, Sr, V, rare earth elements and mixtures thereof.” Ex. 1005, [0010]-[0011]. A POSITA would have been motivated to select Mg and Al from the elements taught by Choi. *See supra* §VII.A.7; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶197-199.

Limitation 1.G also recites that the value for M<sup>2</sup> is “c,” where “c” is “0.0002≤c≤0.02.” Choi discloses that the value for M in Formula 1 is “y,” where “y” is “0≤y≤0.9.” Ex. 1005, [0010]-[0011]. While Choi discloses the possibility of excluding “M” from Formula 1, the inclusion of Mg and Al would provide certain benefits and enhancements to the cathode. Ex. 1024; Ex. 1003, ¶200.

A larger range taught by a prior art reference (e.g., “0≤y≤0.9”) that encompasses or subsumes a smaller claimed range (e.g., “0.0002≤c≤0.02”) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶201. Further, Mg and Al concentration is a result effective variable that

could be optimized via routine experimentation. *See supra* §VII.A.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>6</sup>; Ex. 1022; Ex. 1003, ¶201.

*Choi Formula 1 – M<sup>3</sup>*

Formula 1 of Choi is “Li<sub>x</sub>Co<sub>1-y</sub>M<sub>y</sub>O<sub>2-α</sub>X<sub>α</sub>,” where “M<sup>3</sup>” recited in limitation 1.G is equivalent to “X” in Formula 1. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶202. Choi teaches that “X is selected from the group consisting of O, F, S and P.” Ex. 1005, [0010]-[0011]. Thus, Choi teaches “P” as M<sup>3</sup>. Ex. 1003, ¶202.

Limitation 1.G recites that “d” is “0≤d≤0.02,” and the ’035 Patent further discloses that formula (2) recited in limitation 1.G “may contain no M<sup>3</sup>.” Ex. 1001, 9:24; *see also* Ex. 1026, 9 (asserting that M<sup>3</sup> is “not present”). Choi teaches that the value of “α” is “0≤α≤2” such that α can be 0. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶203. A POSITA would have known that by setting “α” at 0, Formula 1 would provide an oxide O<sub>2</sub> because the value of oxygen in Formula 1 (“O<sub>2-α</sub>”) depends upon the value of “α,” and a POSITA would have further understood that use of an oxide would render the positive electrode active material easier to synthesize. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶203.

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<sup>6</sup> *See supra* n4.

Choi Formula 1 - Oxygen Content

Formula 1 of Choi teaches “O<sub>2</sub>” when the value of “α” is set at 0. Ex. 1003, ¶¶204-205.

Choi Formula 2

Formula 2, which can be used for the larger or smaller diameter active material, also satisfies limitation 1.G. *See supra* §VII.7; Ex. 1001, 7:4-10, 9:24; Ex. 1005, [0010]-[0011], [0041]; Ex. 1017, [0029]; [0031], [0096]; Ex. 1018, [0036]; Ex. 1019; Ex. 1020; Ex. 1021; Ex. 1003, ¶¶206-219. Indeed, Choi Formula 2 discloses broader ranges than those recited in limitation 1.G.

**10. Claim 1: [1.H] has an average particle size from 5 μm to 25 μm,**

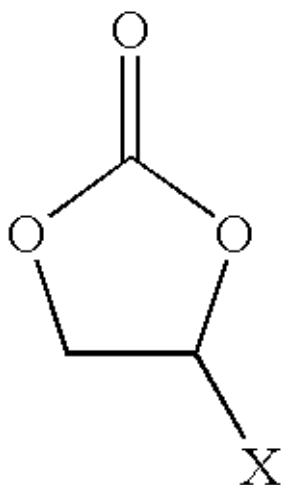
Choi discloses that “[t]he average particle diameter D50 of the large diameter active material may range from about 1 to about 25 μm.” Ex. 1005, [0017], [0046]; Ex. 1003, ¶220. In a non-limiting example, Choi discloses that the average particle diameter of the large diameter active material is 14 μm. Ex. 1005, [0065].

A larger range taught by a prior art reference (e.g., about 1-25 μm) that encompasses or subsumes a smaller claimed range (e.g., 5-25 μm) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶221. Further, particle size is a result effective variable that can be optimized by routine experimentation. *See supra* §VII.A.8; Ex. 1003, ¶221.

**11. Claim 1: [1.I] wherein said electrolyte contains a fluorine-containing organic solvent,**

While Choi discloses a nonaqueous electrolyte (Ex. 1005, [0061]; Ex. 1003, ¶222), Noh includes in its electrolyte “a carbonate-based additive compound” e.g., represented by formula (1):

(1)



“wherein X is selected from the group consisting of a halogen, a cyano (CN), and a nitro (NO<sub>2</sub>)” that is equivalent to “a fluorine-containing organic solvent.” Ex. 1006, [0037], [0039]-[0040]; Ex. 1003, ¶¶223-228. Indeed, Noh expressly teaches using fluoroethylene carbonate as the carbonate-based additive. Ex. 1006, [0064].

**12. Claim 1: [1.J] wherein the content of Co in the transition metal M<sup>1</sup> of the formulae (1) and (2) is from 30% by mole to 100% by mole,**

Formulas 1 and 2 of Choi disclose including Co in the transition metal M<sup>1</sup>.  
See *supra* §§VII.A.7, VII.A.9; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶229-230.

Based on Choi's disclosure of " $0 \leq y \leq 0.9$ " and that the value of Co is equal to " $1-y$ " in Formula 1, Choi Formula 1 teaches a value of Co ranging from 0.1 to 1, which would equate to 10% by mole to 100% by mole. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶231. In non-limiting examples, Choi discloses  $\text{LiCoO}_2$ , which has a value of Co of 1 (i.e. 100%). Ex. 1005, [0073]-[0076].

Based on Choi's disclosure of " $0 \leq y \leq 0.9, 0 \leq z \leq 0.5$ " and that the value of Co is equal to " $1-y-z$ " in Formula 2, Choi Formula 2 teaches a value of Co ranging from 0 to 1, which is equivalent to 0% by mole to 100% by mole. Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶233-234. In a non-limiting example, Choi discloses  $\text{LiCo}_{0.95}\text{Mg}_{0.05}\text{O}_2$ , where Co is 100% of the transition metal  $\text{M}^1$ . Ex. 1005, [0041].

A larger range taught by a prior art reference (e.g., 10-100% (Formula 1), 0-100% (Formula 2)) that encompasses or subsumes a smaller claimed range (e.g., 30-100%) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶¶232, 235-237. Further, Co concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.A.7; Ex. 1017, [0031]<sup>7</sup>; Ex. 1019; Ex. 1020; Ex. 1021; Ex. 1003, ¶¶232, 235-237.

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<sup>7</sup> *See supra* n3.



**13. Claim 1: [1.K] wherein the content of said lithium-containing transition metal oxide having the smallest average particle size in the lithium-containing transition metal oxides is from 5% by weight to 60% by weight,**

Choi discloses that “the weight ratio of the large to the small diameter active materials ranges from about 60:40 to about 90:10.” Ex. 1005, [0034]. A POSITA would have understood that this disclosure in Choi is equivalent to a content of the at least one small diameter active material in Choi of about 10-40%, which falls within the range recited in limitation 1.K. Ex. 1003, ¶238.

**14. Claim 1: [1.L] wherein the content of said lithium-containing transition metal oxide having the largest average particle size in the lithium-containing transition metal oxides is from 40% by weight to 95% by weight, and**

Choi discloses that “the weight ratio of the large to the small diameter active materials ranges from about 60:40 to about 90:10.” Ex. 1005, [0034]. A POSITA would have understood that this disclosure in Choi is equivalent to a content of the at least one small diameter active material in Choi of about 60-90%, which falls within the range recited in limitation 1.L. Ex. 1003, ¶239.

**15. Claim 1: [1.M] wherein an amount of said fluorine-containing organic solvent is 0.1% by weight to 30% by weight based on the whole weight of the electrolyte.**

The combination of Choi and Noh discloses a fluorine-containing organic solvent. *See supra* §VII.A.11; Ex. 1005, [0061]; Ex. 1006, [0037], [0039], [0064]; Ex. 1003, ¶¶240-244.

Noh discloses that “[t]he carbonate-based additive compound is added in an amount of 0.01 to 10 wt %, and preferably 0.01 to 5 wt %, based on the total amount of the electrolyte.” Ex. 1006, [0041]. Indeed, in an example Noh includes “2 wt % of fluoroethylene carbonate based on the total amount of the electrolyte....” Ex. 1006, [0064].

As discussed in §VII.A(1)(ii) *supra*, a POSITA would have been motivated to combine Choi and Noh. Ex. 1003, ¶244.

**16. Claim 2: The nonaqueous secondary battery according to claim 1, wherein the lithium-containing transition metal oxide having the largest average particle size is a lithium-containing transition metal oxide represented by the formula (2) wherein  $c$  and  $d$  satisfy the following equation, respectively:  $0.0002 \leq c < 0.005$  and  $0 \leq d < 0.005$ .**

As discussed with respect to limitation 1.G, this limitation is disclosed by Choi. *See supra* §VII.A.9; Ex. 1005, [0010]-[0011]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]; Ex. 1022; Ex. 1003, ¶¶245-249.

**17. Claim 3: The nonaqueous secondary battery according to claim 2, wherein  $z$  in the formula (1) is larger than  $c$  in the formula (2).**

Both Formulas 1 and 2 of Choi disclose the value of “ $c$ ” in formula (2) of the ’035 Patent. *See supra* §VII.A.16; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>8</sup>; Ex. 1022; Ex. 1003, ¶¶250-256. Formula 2 of Choi discloses the value of “ $z$ ” in

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<sup>8</sup> *See supra* n4.

formula (1) of the '035 Patent. *See supra* §VII.A.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>9</sup>; Ex. 1022; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶250-256. In non-limiting examples, Choi discloses  $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$  or  $\text{LiNi}_{0.5}\text{Mn}_{0.5}\text{O}_2$  as the small diameter active materials, where the values of Mn (i.e.  $\text{M}^2$ ) are 1/3 and 0.5 respectively, and  $\text{LiCoO}_2$  as the large diameter active materials, where the value of  $\text{M}^2$  is 0. Ex. 1005, [0073], [0075]-[0076].

A POSITA would have understood the need to select a higher value of “z” for the small diameter active material than the value of “y” for the large diameter active material in Choi. Ex. 1003, ¶257. Indeed, a POSITA would have understood that because the small diameter active material is made of smaller particles than the large diameter active material, the small diameter active material would have had a higher specific surface area per gram. Ex. 1016; Ex. 1003, ¶257. By having an increased specific surface area, the small diameter active material would be able to charge/discharge to a higher power due, in part, to the higher reactivity that comes with higher specific surface area. Ex. 1016; Ex. 1003, ¶257. A POSITA would have understood that higher reactivity is also linked to lower stability. Ex. 1016; Ex. 1003, ¶257. Because doping elements (e.g., Mg and Al) are known to provide structural enhancements to cathode active materials, a POSITA would have been

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<sup>9</sup> *See supra* n4.

motivated to add a higher concentration of doping elements to the smaller diameter active material than the larger diameter active material in order to increase the stability of the smaller diameter active material. Ex. 1003, ¶257. Accordingly, a POSITA would have selected a larger value for “z” in Formula 2 of Choi than the value for “y” in Formula 1 of Choi. Ex. 1003, ¶257.

**18. Claim 4: The nonaqueous secondary battery according to claim 1, wherein z in the formula (1) is larger than c in the formula (2).**

As discussed with respect to Claim 3, Choi teaches this claim. *See supra* §VII.A.17; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>10</sup>; Ex. 1022; Ex. 1003, ¶¶258-264. Indeed, the only difference between Claims 3 and 4 is that Claim 4 depends from Claim 1, which recites a larger range for “c” of “ $0.0002 \leq c \leq 0.02$ ,” which is taught by Choi. *See supra* §VII.A.9; Ex. 1005, [0010]-[0011]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>11</sup>; Ex. 1022; Ex. 1003, ¶¶250-257.

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<sup>10</sup> *See supra* n4.

<sup>11</sup> *See supra* n4.

**19. Claim 5: [5.A] The nonaqueous secondary battery according to claim 1, wherein, in the formula (1), the metal elements  $M^2$  are Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn;**

As discussed with respect to limitation 1.E, this limitation is disclosed by Choi. *See supra* §VII.A.7; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶265-268.

**20. Claim 5: [5.B] a content of Mg is from 0.1% by mole to less than 2% by mole based on the amount of the transition metal  $M^1$ ;**

As discussed with respect to limitation 1.E, Choi discloses that the value Mg (and possibly another element, e.g., Al) in M based on the amount of the transition metals (i.e.  $M^1$  of the '035 Patent) is " $0 \leq z \leq 0.5$ ," i.e. 0-50%. *See supra* §VII.A.7; Ex. 1005, [0010]-[0011]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>12</sup>; Ex. 1022; Ex. 1003, ¶¶269-273.

A larger range taught by a prior art reference (e.g., 0-50%) that encompasses or subsumes a smaller claimed range (e.g., 0.1% to less than 2%) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶273. Further, Mg and Al concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.A.7; Ex. 1017, [0029],

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<sup>12</sup> *See supra* n4.

[0096]; Ex. 1018, [0036]<sup>13</sup>; Ex. 1022; Ex. 1003, ¶273. Indeed, including too much Mg and Al (i.e. over 2%) would decrease the capacity of the cell. Ex. 1003, ¶273.

**21. Claim 5: [5.C] when Ti, Zr, Ge or Nb is contained, a total content thereof is from 0.05% by mole to less than 0.5% by mole based on the amount of the transition metal M<sup>1</sup>; and**

Petitioner interprets this limitation to not require the presence of Ti, Zr, Ge, or Nb. *Praxair Tech., Inc. v. Entegris, Inc.*, No. IPR2016-01845, Paper 7 at 7 (PTAB Mar. 30, 2017); *In re Johnston*, 435 F.3d 1381, 1384 (Fed. Cir. 2006); MPEP §2103(I)(C); Ex. 1003, ¶274. Choi discloses Mg and Al. *See supra* §VII.A.7; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶275.

**22. Claim 5: [5.D] when Al or Sn is contained, a total content thereof is from 0.1% by mole to less than 1% by mole based on the amount of the transition metal M<sup>1</sup>.**

Choi discloses that the value Mg (and possibly another element, e.g., Al) in M based on the amount of the transition metals (i.e. M<sup>1</sup> of the '035 Patent) is “ $0 \leq z \leq 0.5$ ,” i.e. 0-50%. *See supra* §VII.A.7; Ex. 1005, [0010]-[0011]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>14</sup>; Ex. 1022; Ex. 1003, ¶¶276-280.

A larger range taught by a prior art reference (e.g., 0-50%) that encompasses or subsumes a smaller claimed range (e.g., 0.1% to less than 1%) is sufficient to

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<sup>13</sup> *See supra* n4.

<sup>14</sup> *See supra* n4.

establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶281.

Further, Mg and Al concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.A.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>15</sup>; Ex. 1022; Ex. 1003, ¶281. Indeed, including too much Mg and Al (i.e. over 2%) would decrease the capacity of the cell. Ex. 1003, ¶281.

**23. Claim 6: [6.A] The nonaqueous secondary battery according to claim 1, wherein, in the formula (2), the metal elements  $M^2$  are Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn;**

As discussed with respect to limitation 1.G, this limitation is disclosed by Choi. *See supra* §VII.A.9; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶282-285.

**24. Claim 6: [6.B] a content of Mg is from 0.01% by mole to less than 0.5% by mole based on the amount of the transition metal  $M^1$ ;**

As discussed with respect to limitation 5.B, this limitation is disclosed by Choi. *See supra* §VII.A.20; Ex. 1005, [0010]-[0011]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]; Ex. 1022; Ex. 1003, ¶¶286-290.

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<sup>15</sup> *See supra* n4.

**25. Claim 6: [6.C] when Ti, Zr, Ge or Nb is contained, a total content thereof is from 0.005% by mole to less than 0.3% by mole based on the amount of the transition metal  $M^I$ ; and**

Petitioner interprets this limitation to not require the presence of Ti, Zr, Ge, or Nb. *See supra* §VII.A.21; Ex. 1003, ¶291. Choi discloses Mg and Al. *See supra* §VII.A.9; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶292.

**26. Claim 6: [6.D] when Al or Sn is contained, a total content thereof is from 0.01% by mole to less than 0.5% by mole based on the amount of the transition metal  $M^I$ .**

As discussed with respect to limitation 5.D, this limitation is disclosed by Choi. *See supra* §VII.A.22; Ex. 1005, [0010]-[0011]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]; Ex. 1022; Ex. 1003, ¶¶293-298.

**27. Claim 7: The nonaqueous secondary battery according to claim 1, wherein said positive electrode mixture layer has a density of 3.5 to 4.6 g/cm<sup>3</sup>.**

Choi discloses a density of “3.2 to 4.0 g/cm<sup>3</sup>.” Ex. 1005, [0045]; Ex. 1003, ¶¶299-300. A range taught by a prior art reference that overlaps a claimed range is sufficient to establish a prima facie case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶301.



**28. Claim 8: The nonaqueous secondary battery according to claim 1, wherein said electrolyte further contains a fluorine-containing aromatic compound other than said fluorine-containing organic solvent.**

Choi discloses a nonaqueous electrolyte. Ex. 1005, [0061]; Ex. 1003, ¶302.

Choi does not explicitly disclose a “fluorine containing organic solvent” or “a fluorine-containing aromatic compound.” Ex. 1003, ¶302.

Noh discloses a “fluorine-containing organic solvent.” *See supra* §VII.A.11; Ex. 1006, [0037], [0039], [0064]; Ex. 1003, ¶¶303-308.

Noh also discloses the incorporation of an anisole-based compound as a “swelling-inhibiting additive” as represented by formula (4):



“wherein...X is a halogen....” Ex. 1006, [0050], [0054]-[0055]. Noh provides several examples including “3-fluoroanisole,...4-fluoroanisole,...2,4-difluoroanisole, 3,5-difluoroanisole, 3-chloro-5-fluoroanisole, and the like.” Ex. 1006, [0056]. Formula (4) of Noh represents an aromatic compound. Ex. 1003, ¶303.

As discussed in §VII.A(1)(ii) *supra*, a POSITA would have been motivated to combine Choi and Noh. Ex. 1003, ¶309.

**29. Claim 9: The nonaqueous secondary battery according to claim 1, wherein the fluorine-containing organic solvent is fluoroethylene carbonate.**

Noh explicitly discloses fluoroethylene carbonate as an example of its carbonate-based additive compound, which a POSITA would have understood is a fluorine-containing organic solvent. *See supra* §VII.A.11; Ex. 1006, [0037], [0039], [0064]; Ex. 1003, ¶¶310-317.

**30. Claim 10: The nonaqueous secondary battery according to claim 1, wherein  $M^1$  represents Co.**

Formula 1 of Choi only teaches Co as the transition metal (i.e.  $M^1$  in the '035 Patent), and Formula 2 of Choi also only teaches Co as the transition metal when the value of “y” is 0. *See supra* §§VII.A.7, VII.A.9; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶318-319.

**31. Claim 11: A method of using a nonaqueous secondary battery according to claim 1 comprising the step of: charging the battery so that a positive electrode voltage is in a range of 4.35 to 4.6 V with reference to the potential of lithium when the battery is fully charged.**

Choi discloses a positive electrode voltage range of “4.2 V or greater” “relative to lithium metal.” Ex. 1005, [0040]; Ex. 1003, ¶¶320-322. Choi also discloses examples using 4.2V, 4.3V, and 4.5V, with discharge capacity increasing with voltage. Ex. 1005, [0088], Table 2; Ex. 1003, ¶320. Based on Choi’s

disclosures of increasing capacity with voltage, a POSITA would have been motivated to select a voltage of 4.5V. Ex. 1003, ¶320.

TABLE 2

|                          | Discharge capacity<br>after charging to<br>4.2 V (mAh/g) | Discharge capacity<br>after charging to<br>4.3 V (mAh/g) | Discharge capacity<br>after charging to<br>4.5 V (mAh/g) |
|--------------------------|--|--|--|
| Example 8                | 143  | 158  | 187  |
| Example 9                | 139  | 156  | 183  |
| Example 10               | 144  | 159  | 191  |
| Example 11               | 138  | 155  | 182  |
| Comparative<br>example 4 | 145  | 159  | 179  |

## **B. GROUND 2: THE COMBINATION OF NEGISHI AND KITA RENDERS OBVIOUS CLAIMS 1-6, 9-11**

### ***1. Overview of Ground 2***

#### **i. Negishi and Kita**

Negishi discloses a “nonaqueous-electrolyte secondary battery” with “a cathode” including at least two lithium-containing transition metal oxides having different average particle sizes. Ex. 1007, [0006], [0008], [0017], [0025], [0026]; Ex. 1003, ¶¶323-328.

Kita discloses a lithium nonaqueous secondary battery. Ex. 1008, [0014]-[0015], [0017]; Ex. 1003, ¶¶329-331. Kita discloses a nonaqueous electrolyte including a fluorine-containing organic solvent. Ex. 1008, [0015], [0024], [0026], [0030]; Ex. 1003, ¶¶332-333.

## ii. Motivation to Combine

Negishi discloses a nonaqueous electrolyte including an organic solvent. Ex. 1007, [0008], [0017], [0025], [0026], [0032]; Ex. 1003, ¶335. Negishi does not teach the inclusion of a fluorine-containing organic solvent in its nonaqueous electrolyte. Ex. 1003, ¶336.

Negishi does teach that improving capacity is a goal of its lithium secondary batteries. Ex. 1007, [0006], [0060]; Ex. 1003, ¶336. Improving battery capacity drove lithium ion battery development at the time of Negishi, Kita, and the '035 Patent, since competing applications for these batteries sought longer runtimes for their products. Ex. 1010, 267; Ex. 1003, ¶336. Thus, a POSITA would have looked to Kita and its inclusion of a fluorine-containing organic solvent in its electrolyte to improve capacity. Ex. 1003, ¶337. Kita, which teaches the same types of cathode and anode materials as Negishi, identifies shortcomings of these cathode and anode active materials, including a need for increased protection for cathode active materials at the high voltages needed to increase capacity. Ex. 1007, [0008], [0017], [0025], [0026]; Ex. 1008, [0014]-[0015], [0017], [0024]-[0026]; Ex. 1003, ¶337.

Both Kita and Negishi teach the inclusion of a nonaqueous organic solvent in their electrolytes. Ex. 1007, [0026], [0032]; Ex. 1008, [0015], [0030]; Ex. 1003, ¶338. Kita also teaches that the organic fluorine-based solvent in its electrolyte

forms a protective film on the positive electrode active material surface during initial battery charging. Ex. 1008, [0024]; Ex. 1003, ¶339.

Thus, a POSITA would have been motivated to improve the Negishi battery by incorporating the electrolyte additive of Kita to increase battery capacity. Ex. 1008, [0014]-[0015], [0024]-[0026]; Ex. 1003, ¶340.

Because both references disclose similar cathode, anode, and electrolyte materials, and because lithium-ion chemistry was predictable at the time of Negishi, Kita, and the '035 Patent, a POSITA would have also had a reasonable expectation of success in combining Negishi and Kita. Ex. 1007, [0008], [0017], [0025], [0026], [0032]; Ex. 1008, [0014]-[0015], [0017], [0024]-[0026], [0030]; Ex. 1003, ¶¶40, 341. A POSITA would have further had a reasonable expectation of success because both Negishi and Kita seek to increase capacity in the disclosed batteries. Ex. 1007, [0006]; Ex. 1008, [0014]-[0015]; Ex. 1003, ¶341. Finally, a POSITA would have had a reasonable expectation of success because Kita demonstrated that a fluorine-containing carbonate ester was added to cathode materials comprising lithium complex metal oxide cathode active materials and anode materials comprising graphite, just like Negishi. Ex. 1008, [0014]-[0015], [0024]-[0026]; Ex. 1003, ¶341. Thus, a POSITA would have expected adding Kita's organic fluorine-based solvent to Negishi's battery to be effective. Ex. 1003, ¶341.

A POSITA would have been motivated to combine Negishi and Kita because doing so would result in a simple substitution of the electrolyte of Negishi with that of Kita. The only difference between Negishi and the '035 Patent claims is the inclusion of fluorine-based electrolyte additives. Ex. 1003, ¶337. Kita discloses the same electrolyte as Negishi with the addition of organic fluorine-based solvent to protect the cathode active materials at the high voltages needed to increase capacity. Ex. 1007, [0026], [0032]; Ex. 1008, [0015], [0024], [0030]; Ex. 1003, ¶337. Thus, a POSITA would have understood that the electrolyte of Negishi could simply be substituted with the electrolyte of Kita, and the results would have been predictable. Ex. 1003, ¶¶337-342.

## ***2. Claim 1: [1.Pre]***

To the extent the preamble is limiting, Negishi and Kita disclose a nonaqueous secondary battery. Ex. 1007, [0001] (“nonaqueous-electrolyte secondary battery”); Ex. 1008, [0014]; Ex. 1003, ¶¶343-345.

## ***3. Claim 1: [1.A]***

Negishi discloses “a cathode” formed by “coating a cathode mixture...on a cathode plate” as a layer. Ex. 1007, [0026]; Ex. 1003, ¶346.

Kita also discloses “a positive electrode formed by forming a positive electrode mixture layer on at least one surface of a positive electrode current collector.” Ex. 1008, [0015]; Ex. 1003, ¶347.

**4. Claim 1: [1.B]**

Negishi discloses “an anode.” Ex. 1007, [0026]; Ex. 1003, ¶348.

Kita discloses “a negative electrode.” Ex. 1008, [0015]; Ex. 1003, ¶349.

**5. Claim 1: [1.C]**

Negishi and Kita each disclose “a nonaqueous electrolyte.” Ex. 1007, [0026]; Ex. 1008, [0015]; Ex. 1003, ¶¶350-351.

**6. Claim 1: [1.D]**

Negishi explicitly discloses that “the cathode active material of the present invention can be obtained by uniformly mixing, in advance, *two or more types of lithium complex oxide particles having different average particle sizes.*” Ex. 1007, [0022] (emphasis added); Ex. 1003, ¶352.

**7. Claim 1: [1.E]**

Negishi discloses:

A cathode active material used as a cathode active material of the present invention is a lithium complex oxide indicated by the general formula [Chem. 5]  $Li_xM_{1-y}N_yO_{2-z}$  (in the formula, *M representing Co, Ni, or Mn*; N representing a transition metal element other than M or one or more elements selected from a group consisting of elements having an atomic number of 11 or greater; x representing a number within a range of  $0.2 \leq x \leq 1.2$ ; y representing a number within a range of  $0 \leq y \leq 0.5$ ; and z representing a number within a range of  $0 \leq z \leq 1.0$ )....Specifically, N is preferably one or more elements

selected from among *Mg*, *Al*, Ca, *Ti*, V, Cr, Mn, Fe, Co, Ni, Zn, Ga, Zr, Nb, W, and Mo. However, M and N are never the same element.

Ex. 1007, [0014]-[0015]. Negishi also discloses “two or more types of lithium complex oxide particles having different average particle sizes.” Ex. 1007, [0022]. Thus, a POSITA would have understood that the above formula can apply to the lithium complex oxide particles having both the smallest and largest average particle sizes. Ex. 1003, ¶¶353-355.

### Lithium Content

Negishi teaches that the value of “x” in  $\text{Li}_x$  is “ $0.2 \leq x \leq 1.2$ ,” while the value of “x” in  $\text{Li}_x$  recited in limitation 1.E is “ $0.97 \leq x < 1.02$ .” Ex. 1007, [0014]; Ex. 1003, ¶356. A larger range taught by a prior art reference (e.g., “ $0.2 \leq x \leq 1.2$ ”) that encompasses or subsumes a smaller claimed range (e.g., “ $0.97 \leq x < 1.02$ ”) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶357. Indeed, a POSITA would have been motivated to select a value of x approximately equal to 1, and the ’035 Patent confirms this understanding. Ex. 1003, ¶358; Ex. 1001, 7:4-10. In a non-limiting example, Negishi discloses  $\text{LiNi}_{0.7}\text{Co}_{0.3}\text{O}_2$ , which has a value of x equal to 1. Ex. 1007, [0016].



$M^1$

Negishi also discloses “ $M^1_y$ ” recited in limitation 1.E. Specifically, the formula taught by Negishi is “ $Li_xM_{1-y}N_yO_{2-z}$ ,” where “M represent[s] Co, Ni or Mn.” Ex. 1007, [0014]; Ex. 1003, ¶¶360-361.

Limitation 1.E teaches that the value for  $M^1$  is “y,” where “y” is “ $0.8 \leq y < 1.02$ .” Based on Negishi’s disclosure that the value for “M” is “1-y,” where “y” is “ $0 \leq y \leq 0.5$ ,” a POSITA would have understood that Negishi teaches that the value of “M” is 0.5 to 1. Ex. 1007, [0014]; Ex. 1003, ¶361. In a non-limiting example, Negishi discloses  $LiCoO_2$ , which has a value of Co of 1. Ex. 1007, [0038].

A range taught by a prior art reference that overlaps a claimed range is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶362. Further, a POSITA would have understood that Co concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.A.7; Ex. 1017, [0031]<sup>16</sup>; Ex. 1019; Ex. 1020; Ex. 1021; Ex. 1003, ¶362.

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<sup>16</sup> *See supra* n3. To be clear, this ground is obviousness in view of Negishi and Kita. Sato does not form part of the combination/modification. Rather, Sato is provided to establish the POSITA’s base knowledge.

$M^2$

Negishi also discloses “ $M_z^2$ ” recited in limitation 1.E. Specifically, the formula taught by Negishi is “ $Li_xM_{1-y}N_yO_{2-z}$ ,” where  $M^2$  recited in limitation 1.E is equivalent to “N” in the formula of Negishi. Ex. 1007, [0014]-[0015]; Ex. 1003, ¶363. Indeed, Negishi discloses that “N is preferably one or more elements selected from among Mg, Al, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Ga, Zr, Nb, W, and Mo.” Ex. 1007, [0015]. As such, a POSITA would have understood that Negishi discloses Mg and Al and/or Ti. Ex. 1007, [0014]-[0015]; Ex. 1003, ¶363.

Indeed, a POSITA would have been motivated to select Mg and Al and/or Ti from the list of elements taught by Negishi for multiple reasons. Ex. 1003, ¶¶363-365. First, each doping element (e.g., Mg, Al, Ti, etc.) plays a different role in modifying the material properties of the host material (e.g., lithium cobalt oxide), with Mg enhancing the material’s electronic conductivity, and Al providing structural enhancement to the cathode. Ex. 1024; Ex. 1003, ¶364. Further, a POSITA would have understood that Mg, Al, and Ti are the smallest elements Negishi teaches, meaning that Mg, Al, and Ti are less likely to disrupt the structure of the positive electrode active material. Ex. 1024; Ex. 1025; Ex. 1003, ¶365. Moreover, a POSITA would have understood that Mg and Al have singular oxidation states of +2 and +3, respectively, allowing these atoms to reside in the structure of the cathode material without being oxidized or reduced. Ex. 1024; Ex.

1003, ¶365. Thus, Mg, Al, and Ti have stable oxidation states, as well as sizes suitable to fit in the metal oxide structure without causing structural strain. Ex. 1024; Ex. 1025; Ex. 1003, ¶365. For all of these reasons described herein, a POSITA would have been motivated to select Mg and Al and/or Ti, in particular from the list of elements for “N” taught by Negishi. Ex. 1003, ¶365.

Limitation 1.E also requires that the value for  $M^2$  is “z,” where “z” is “ $0.002 \leq z \leq 0.05$ .” Negishi discloses that the value for “N” in its formula is “y,” where “y” is “ $0 \leq y \leq 0.5$ .” Ex. 1007, [0014]. Although Negishi does contemplate the possibility of including no “N” in its formula, a POSITA would have understood that including Mg and Al and/or Ti would provide certain benefits and enhancements to the cathode. Ex. 1025; Ex. 1003, ¶366.

A larger range taught by a prior art reference (e.g., “ $0 \leq y \leq 0.5$ ”) that encompasses or subsumes a smaller claimed range (e.g., “ $0.002 \leq z \leq 0.05$ ”) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7 (“Lithium Content”); Ex. 1003, ¶367. Further, a POSITA would have understood that Mg and Al and/or Ti concentration is a result effective variable because increasing Mg and Al and/or Ti concentration is known to increase the stability of the cathode structure, albeit at the expense of transition metal content. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295-96 (Fed. Cir. 2012); Ex. 1003, ¶367. Thus, the optimum range of Mg and Al and/or Ti concentration could have been

discovered by routine experimentation. *Id.* Indeed, a POSITA would have been motivated to use as small an amount of Mg and Al and/or Ti as possible necessary to stabilize the structure, as a POSITA would have understood that Mg and Al and/or Ti do not participate in the electrochemical reaction and are present at the expense of Co and/or Ni, which are electrochemically active and contribute to the battery's capacity. Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>17</sup>; Ex. 1022; Ex. 1003, ¶367.

### M<sup>3</sup>

Limitation 1.E recites that that “v” is “ $0 \leq v \leq 0.05$ ,” and the '035 Patent further discloses that formula (1) recited in limitation 1.E “may contain no M<sup>3</sup>.” Ex. 1001, 9:24; *see also* Ex. 1026, 7 (asserting that M<sup>3</sup> is “not present”). The formula taught by Negishi is “Li<sub>x</sub>M<sub>1-y</sub>N<sub>y</sub>O<sub>2-z</sub>.” Ex. 1007, [0014]. Because M<sup>3</sup> is optional, a POSITA would have understood that M<sup>3</sup> is not present in Negishi and is not required to be present by the claims. Ex. 1003, ¶368.

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<sup>17</sup> *See supra* n4. To be clear, this ground is obviousness in view of Negishi and Kita. Sato and Watanabe do not form part of the combination/modification. Rather, Sato and Watanabe are provided to establish the POSITA's base knowledge.

Oxygen Content

The formula taught by Negishi is “ $\text{Li}_x\text{M}_{1-y}\text{N}_y\text{O}_{2-z}$ ,” where  $z$  can be 0.

Ex. 1007, [0014]; Ex. 1003, ¶¶369-370.

**8. Claim 1: [1.F]**

Negishi discloses that “an average particle size of a lithium complex oxide such as above constituting the cathode active material is within a range of 0.1 to 50  $\mu\text{m}$ —preferably, 0.3 to 40  $\mu\text{m}$ .” Ex. 1007, [0017]. Negishi discloses a range of particle size ratios, with the smallest value for the small particle size being 0.5  $\mu\text{m}$ , and the largest value for the small particle size being 10  $\mu\text{m}$ . Ex. 1007, [0025]. Thus, a POSITA would have understood that Negishi teaches a range of average particle sizes for the lithium composite oxide particles having a small average particle size of 0.5-10  $\mu\text{m}$ . Ex. 1003, ¶¶371-372.

A larger range taught by a prior art reference (e.g., 0.5-10  $\mu\text{m}$ ) that encompasses or subsumes a smaller claimed range (e.g., 2-10  $\mu\text{m}$ ) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶373.

Further, a POSITA would have understood that particle size is a result effective variable that can be optimized by routine experimentation. *See supra* §VII.A.8; Ex. 1003, ¶373.

### 9. Claim 1: [1.G]

Negishi discloses lithium complex oxide indicated by the general formula [Chem. 5]  $Li_xM_{1-y}N_yO_{2-z}$ . Ex. 1007, [0014]-[0015]; *see supra* §VII.B.6.

Negishi also discloses “two or more types of lithium complex oxide particles having different average particle sizes.” Ex. 1007, [0022]. Thus, a POSITA would have understood that the above formula can apply to the lithium complex oxide particles having both the smallest and largest average particle sizes. Ex. 1003, ¶¶374-375.

#### Lithium Content

Negishi teaches that the value of “x” in  $Li_x$  is “ $0.2 \leq x \leq 1.2$ ,” while the value of “a” in  $Li_a$  recited in limitation 1.G is “ $0.97 \leq a < 1.02$ .” Ex. 1007, [0014]; Ex. 1003, ¶376. A larger range taught by a prior art reference (e.g., “ $0.2 \leq x \leq 1.2$ ”) that encompasses or subsumes a smaller claimed range (e.g., “ $0.97 \leq a < 1.02$ ”) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶377. Indeed, a POSITA would have been motivated to select a value of x approximately equal to 1, and the ’035 Patent confirms this understanding. Ex. 1003, ¶378; Ex. 1001, 7:4-10. In a non-limiting example, Negishi discloses  $LiNi_{0.7}Co_{0.3}O_2$ , which has a value of x equal to 1. Ex. 1007, [0016].

$M^I$

Negishi also discloses “ $M^I_b$ ” recited in limitation 1.G. Specifically, the formula taught by Negishi is “ $Li_xM_{1-y}N_yO_{2-z}$ ,” with “M representing Co, Ni, or Mn.” Ex. 1007, [0014]; Ex. 1003, ¶¶380-381.

Limitation 1.G teaches that the value for  $M^I$  is “b,” where “b” is “ $0.8 \leq b < 1.02$ .” Based on Negishi’s disclosure that the value for “M” is “ $1-y$ ,” where “y” is “ $0 \leq y \leq 0.5$ ,” a POSITA would have understood that Negishi teaches that the value of “M” is 0.5 to 1. Ex. 1007, [0014]; Ex. 1003, ¶382. In a non-limiting example, Negishi discloses  $LiCoO_2$ , which has a value of Co of 1. Ex. 1007, [0038].

A range taught by a prior art reference that overlaps a claimed range is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶383. Further, a POSITA would have understood that Co concentration is a result effective variable that could be optimized by routine experimentation. *See supra* §VII.A.7; Ex. 1017, [0031]<sup>18</sup>; Ex. 1019; Ex. 1020; Ex. 1021; Ex. 1003, ¶383.

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<sup>18</sup> *See supra* n16.

$M^2$

Negishi also discloses “ $M^2_c$ ” recited in limitation 1.G. Specifically, the formula taught by Negishi is “ $Li_xM_{1-y}N_yO_{2-z}$ ,” where  $M^2$  recited in limitation 1.G is equivalent to “N” in the formula of Negishi. Ex. 1007, [0014]-[0015]; Ex. 1003, ¶384. Indeed, Negishi discloses that “N is preferably one or more elements selected from among Mg, Al, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Ga, Zr, Nb, W, and Mo.” Ex. 1007, [0015]. As such, a POSITA would have understood that Negishi discloses Mg and Al and/or Ti. *See supra* §VII.B.7; Ex. 1007, [0014]-[0015]; Ex. 1003, ¶¶384-386.

Limitation 1.G also requires that the value for  $M^2$  is “c,” where “c” is “ $0.0002 \leq z \leq 0.02$ .” Negishi discloses that the value for “N” in its formula is “y,” where “y” is “ $0 \leq y \leq 0.5$ .” Ex. 1007, [0014]. Although Negishi does contemplate the possibility of including no “N” in its formula, a POSITA would have understood that including Mg and Al and/or Ti would provide certain benefits and enhancements to the cathode. Ex. 1024; Ex. 1003, ¶387.

A larger range taught by a prior art reference (e.g., “ $0 \leq y \leq 0.5$ ”) that encompasses or subsumes a smaller claimed range (e.g., “ $0.0002 \leq z \leq 0.02$ ”) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶388. Mg and Al and/or Ti concentration is a result effective variable that



could be optimized via routine experimentation. *See supra* §VII.B.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>19</sup>; Ex. 1022; Ex. 1003, ¶388.

### M<sup>3</sup>

Limitation 1.G recites that that “d” is “ $0 \leq d \leq 0.02$ ,” and the ’035 Patent further discloses that formula (2) recited in limitation 1.G “may contain no M<sup>3</sup>.” Ex. 1001, 9:24; *see also* Ex. 1026, 9 (asserting that M<sup>3</sup> is “not present”). The formula taught by Negishi is “Li<sub>x</sub>M<sub>1-y</sub>N<sub>y</sub>O<sub>2-z</sub>.” Ex. 1007, [0014]. Because M<sup>3</sup> is optional, a POSITA would have understood that M<sup>3</sup> is not present in Negishi and is not required to be present by the claims. Ex. 1003, ¶389.

### Oxygen Content

The formula taught by Negishi is “Li<sub>x</sub>M<sub>1-y</sub>N<sub>y</sub>O<sub>2-z</sub>,” where z can be 0. Ex. 1007, [0014]. Ex. 1003, ¶¶390-391.

### **10. Claim 1: [1.H]**

Negishi discloses that “an average particle size of a lithium complex oxide such as above constituting the cathode active material is within a range of 0.1 to 50 μm—preferably, 0.3 to 40 μm.” Ex. 1007, [0017]. Negishi discloses a range of particle size ratios, with the smallest value for the small particle size being 0.8 μm, and the largest value for the small particle size being 30 μm. Ex. 1007,

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<sup>19</sup> *See supra* n17.

[0025]. Thus, Negishi teaches a range of average particle sizes for the lithium composite oxide particles having a large average particle size of 8-30  $\mu\text{m}$ . Ex. 1003, ¶¶392-393.

A range taught by a prior art reference that overlaps a claimed range is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶394.

Further, particle size is a result effective variable that can be optimized by routine experimentation. *See supra* §VII.A.8; Ex. 1003, ¶394.

### ***11. Claim 1: [1.I]***

Negishi discloses a number of organic electrolyte solvents but does not explicitly disclose “a fluorine-containing organic solvent.” Ex. 1007, [0026], [0032]; Ex. 1003, ¶395.

Kita, however, teaches “a fluorine-containing organic solvent.” Specifically, Kita includes in its electrolyte “an organic fluorine-based solvent such as a fluorine-containing carbonic acid ester.” Ex. 1008, [0024]; Ex. 1003, ¶396.

### ***12. Claim 1: [1.J]***

Negishi discloses including Co in the transition metal  $M^1$ . *See supra* §§VII.B.7, VII.B.9; Ex. 1007, [0014]; Ex. 1003, ¶¶398-401.

Based on Negishi’s disclosure that “M represent[s] Co, Ni *or* Mn,” M can be only one of Co, Ni, or Mn, such that that element is 100% of the transition metal M

(and similarly M<sup>1</sup>). Ex. 1007, [0014]; Ex. 1003, ¶402. In a non-limiting example, Negishi discloses LiCoO<sub>2</sub>, which has a value of Co of 1 (i.e. 100%). Ex. 1007, [0038]. Accordingly, the range of Co concentration taught by Negishi falls within the range recited in limitation 1.J. Ex. 1003, ¶402. Indeed, a POSITA would have been motivated to select as high a Co concentration as reasonably possible to optimize the thermal stability and capacity of the battery. Ex. 1017, [0031]<sup>20</sup>; Ex. 1019; Ex. 1020; Ex. 1021; Ex. 1003, ¶403.

### ***13. Claim 1: [1.K]***

Negishi discloses “a combination ratio of the lithium complex oxide particles of the smaller average particle size being 20 to 40% by weight.” Ex. 1007, [0011]. Thus, the content of the lithium composite oxide particles having the smaller average particle size in Negishi falls within the range recited in limitation 1.K. Ex. 1003, ¶404.

### ***14. Claim 1: [1.L]***

Negishi discloses “a combination ratio of lithium complex oxide particles of the larger average particle size being 60 to 80% by weight....” Ex. 1007, [0011]. Thus, the content of the lithium composite oxide particles having the larger

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<sup>20</sup> See *supra* n16.

average particle size in Negishi falls within the recited in limitation 1.L. Ex. 1003, ¶405.

**15. Claim 1: [1.M]**

The combination of Negishi and Kita discloses a fluorine-containing organic solvent. *See supra* §VII.B.11; Ex. 1007, [0026], [0032]; Ex. 1008, [0024]; Ex. 1003, ¶¶406-407.

Kita discloses a concentration of its “organic fluorine-based solvent” of “preferably 30% by weight or less, more preferably 10% by weight or less, and further preferably 0.1% by weight or more, based on the total amount of the electrolyte salt and the whole solvent (including the polymer in the case of the polymer electrolyte).” Ex. 1008, [0026]; Ex. 1003, ¶407.

As discussed in §VII.B(1)(ii) *supra*, a POSITA would have been motivated to combine Negishi and Kita. Ex. 1003, ¶408.

**16. Claim 2**

As discussed with respect to limitation 1.G, this limitation is disclosed by Negishi. *See supra* §VII.B.9; Ex. 1007, [0014]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]; Ex. 1022; Ex. 1003, ¶¶409-413.

### 17. Claim 3

Negishi discloses the value of “c” in formula (2) of the ’035 Patent. *See supra* §VII.B.16; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>21</sup>; Ex. 1022; Ex. 1003, ¶¶414-416. Negishi discloses the value of “z” in formula (1) of the ’035 Patent. *See supra* §VII.B.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>22</sup>; Ex. 1022; Ex. 1007, [0014]-[0015]; Ex. 1003, ¶¶414-416.

A POSITA would have understood the need to select a higher value of “y” for the small diameter active material than the value of “y” for the large diameter active material in Negishi. Ex. 1007, [0022]; Ex. 1003, ¶417. Indeed, because the small diameter active material is made of smaller particles than the large diameter active material, the small diameter active material would have had a higher specific surface area per gram. Ex. 1016; Ex. 1003, ¶417. By having an increased specific surface area, the small diameter active material would be able to charge/discharge to a higher power due, in part, to the higher reactivity that comes with higher specific surface area. *Id.* Higher reactivity is also linked to lower stability. *Id.* Because doping elements (e.g., Mg and Al) are known to provide structural enhancements to cathode active materials, a POSITA would have been motivated

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<sup>21</sup> *See supra* n17.

<sup>22</sup> *See supra* n17.

to add a higher concentration of doping elements to the smaller diameter active material than the larger diameter active material in order to increase the stability of the smaller diameter active material. Ex. 1016; Ex. 1022; Ex. 1024; Ex. 1003, ¶417. Accordingly, a POSITA would have selected a larger value for “y” for the smaller particles in Negishi than the value for “y” for the larger particles in Negishi. Ex. 1003, ¶417.

#### **18. Claim 4**

As discussed with respect to Claim 3, this limitation is disclosed by Negishi. *See supra* §VII.B.17; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>23</sup>; Ex. 1022; Ex. 1003, ¶¶418-421. Indeed, the only difference between Claims 3 and 4 is that Claim 4 depends from Claim 1, which recites a larger range for “c” of “ $0.0002 \leq c \leq 0.02$ ,” which is taught by Negishi. *See supra* §VII.B.9; Ex. 1007, [0014]-[0015]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>24</sup>; Ex. 1022; Ex. 1003, ¶¶414-417.

#### **19. Claim 5: [5.A]**

As previously discussed with respect to limitation 1.E, this limitation is disclosed by Negishi. *See supra* §VII.B.7; Ex. 1007, [0014]-[0015]; Ex. 1003, ¶¶422-425.

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<sup>23</sup> *See supra* n17.

<sup>24</sup> *See supra* n17.

## 20. Claim 5: [5.B]

Negishi discloses that the value of Mg (and possibly another element, e.g., Al and/or Ti) in N based on the amount of the transition metals (i.e.  $M^1$  of the '035 Patent) is " $0 \leq y \leq 0.5$ ," i.e. 0-50%. *See supra* §VII.B.7; Ex. 1007, [0014]-[0015]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>25</sup>; Ex. 1022; Ex. 1003, ¶¶426-429.

A larger range taught by a prior art reference (e.g., 0-50%) that encompasses or subsumes a smaller claimed range (e.g., 0.1% to less than 2%) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶430. Further, Mg and Al and/or Ti concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.B.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>26</sup>; Ex. 1022; Ex. 1003, ¶430. Indeed, including too much Mg and Al and/or Ti (i.e. over 2%) would decrease the capacity of the cell. Ex. 1003, ¶430.

## 21. Claim 5: [5.C]

Negishi discloses that the value of Mg (and possibly another element, e.g., Al and/or Ti) in N based on the amount of the transition metals (i.e.  $M^1$  of the '035

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<sup>25</sup> *See supra* n17.

<sup>26</sup> *See supra* n17.

Patent) is “ $0 \leq y \leq 0.5$ ,” i.e. 0-50%. *See supra* §VII.B.7; Ex. 1007, [0014]-[0015]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>27</sup>; Ex. 1022; Ex. 1003, ¶¶431-435.

A larger range taught by a prior art reference (e.g., 0-50%) that encompasses or subsumes a smaller claimed range (e.g., 0.05% to less than 0.5%) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶436. Further, Mg and Al and/or Ti concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.B.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>28</sup>; Ex. 1022; Ex. 1003, ¶436. Indeed, including too much Mg and Al and/or Ti (i.e. over 2%) would decrease the capacity of the cell. Ex. 1003, ¶436.

## 22. Claim 5: [5.D]

As previously discussed with respect to limitation 1.E, Negishi discloses that the value of Mg (and possibly another element, e.g., Al and/or Ti) in N based on the amount of the transition metals (i.e. M<sup>1</sup> of the '035 Patent) is “ $0 \leq y \leq 0.5$ ,” i.e. 0-50%. *See supra* §VII.B.7; Ex. 1007, [0014]-[0015]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>29</sup>; Ex. 1022; Ex. 1003, ¶¶437-441.

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<sup>27</sup> *See supra* n17.

<sup>28</sup> *See supra* n17.

<sup>29</sup> *See supra* n17.



A larger range taught by a prior art reference (e.g., 0-50%) that encompasses or subsumes a smaller claimed range (e.g., 0.1% to less than 1%) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶442. Further, Mg and Al and/or Ti concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.B.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>30</sup>; Ex. 1022; Ex. 1003, ¶442. Indeed, including too much Mg and Al and/or Ti (i.e. over 2%) would decrease the capacity of the cell. Ex. 1003, ¶442.

### **23. Claim 6: [6.A]**

As previously discussed with respect to limitation 1.G, this limitation is disclosed by Negishi. *See supra* §VII.B.9; Ex. 1007, [0014]-[0015]; Ex. 1003, ¶¶443-446.

### **24. Claim 6: [6.B]**

As discussed with respect to limitation 5.B, this limitation is disclosed by Negishi. *See supra* §VII.B.20; Ex. 1007, [0014]-[0015]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>31</sup>; Ex. 1022; Ex. 1003, ¶¶447-451.

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<sup>30</sup> *See supra* n17.

<sup>31</sup> *See supra* n17.

### 25. Claim 6: [6.C]

Negishi discloses that the value of Mg (and possibly another element, e.g., Al and/or Ti) in N based on the amount of the transition metals (i.e. M<sup>1</sup> of the '035 Patent) is “ $0 \leq y \leq 0.5$ ,” i.e. 0-50%. *See supra* §VII.B.9; Ex. 1007, [0014]-[0015]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>32</sup>; Ex. 1022; Ex. 1003, ¶¶452-456.

A larger range taught by a prior art reference (e.g., 0-50%) that encompasses or subsumes a smaller claimed range (e.g., 0.005% to less than 0.3%) is sufficient to establish a *prima facie* case of obviousness. *See supra* §VII.A.7; Ex. 1003, ¶457. Further, Mg and Al and/or Ti concentration is a result effective variable that could be optimized via routine experimentation. *See supra* §VII.B.7; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]<sup>33</sup>; Ex. 1022; Ex. 1003, ¶457. Indeed, including too much Mg and Al and/or Ti (i.e. over 2%) would decrease the capacity of the cell. Ex. 1003, ¶457.

### 26. Claim 6: [6.D]

As discussed with respect to limitation 5.D, this limitation is disclosed by Negishi. *See supra* §VII.B.22; Ex. 1007, [0014]-[0015]; Ex. 1017, [0029], [0096]; Ex. 1018, [0036]; Ex. 1022; Ex. 1003, ¶¶458-464-.

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<sup>32</sup> *See supra* n17.

<sup>33</sup> *See supra* n17.

### 27. *Claim 9*

As discussed with respect to limitation 1.I, Kita discloses “an organic fluorine-based solvent such as a fluorine-containing carbonic acid ester.” *See supra* §VII.B.11; Ex. 1008, [0024]; Ex. 1003, ¶466. Fluoroethylene carbonate is an example of “an organic fluorine-based solvent” or “fluorine-containing carbonic acid ester” taught by Kita. Ex. 1003, ¶466.

As discussed in §VII.B(1)(ii) *supra*, a POSITA would have been motivated to combine Negishi and Kita. Ex. 1003, ¶467.

### 28. *Claim 10*

As discussed with respect to limitations 1.E and 1.G, Negishi discloses teaches Co as the transition metal (i.e. M<sup>1</sup> in the '035 Patent). *See supra* §§VII.B.7, VII.B.9; Ex. 1005, [0010]-[0011]; Ex. 1003, ¶¶468-472. Further, Negishi explicitly teaches that its lithium composite oxide particles can be represented by “Li<sub>x</sub>CoO<sub>2</sub>...or a portion of the Co...substituted by another metallic element. Ex. 1007, [0014]. Further, Co concentration is a result effective variable that could be optimized by routine experimentation. *See supra* §VII.A.7; Ex. 1017, [0031]<sup>34</sup>; Ex. 1019; Ex. 1020; Ex. 1021; Ex. 1003, ¶472.

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<sup>34</sup> *See supra* n16.

## 29. *Claim 11*

Negishi describes calculating cycle characteristics by charging the positive electrode to 4.3 V. Ex. 1007, [0058]; Ex. 1003, ¶473. Kita, however, discloses that “the non-aqueous secondary battery of the present invention can be charged up to a region in which the upper limit value of the positive electrode potential is 4.4 V or more and 4.6 V or less at the Li reference potential,” which falls within the range recited in Claim 11. Ex. 1008, [0021]; Ex. 1003, ¶¶474-477.

### **C. GROUND 3: THE COMBINATION OF NEGISHI, KITA, AND ISHIKAWA RENDERS OBVIOUS CLAIM 8**

#### *1. Overview of Ground 3*

##### *i. Negishi, Kita, and Ishikawa*

Negishi and Kita were described with respect to Ground 2. *See supra* §VII.B.1.i. Ishikawa discloses a nonaqueous electrolyte including a fluorine-containing aromatic compound. Ex. 1009, [0005], [0015]; Ex. 1003, ¶¶480-485.

##### *ii. Motivation to Combine*

The motivation to combine Negishi and Kita was described with respect to Ground 2. *See supra* §VII.B.1.ii; Ex. 1003, ¶¶487-491. Negishi and Kita do not explicitly disclose a fluorine-containing aromatic compound. Ex. 1003, ¶492.

Ishikawa discloses an “aromatic compound...capable of forming a coating on the surface of an active material of a positive or negative electrode” including examples such as “fluorobenzene, difluorobenzene, trifluorobenzene,...[and]

fluoroanisole.” Ex. 1009, [0015]. As with Kita, Ishikawa’s electrolyte additive forms a protective surface coating on an active material to improve battery safety. Ex. 1009, [0015]; Ex. 1003, ¶492. Ishikawa discloses the same types of cathode and anode materials and nonaqueous electrolyte solvents, as Negishi and Kita. Ex. 1007, [0008], [0017], [0025], [0026], [0032]; Ex. 1008, [0014]-[0015], [0017], [0024]-[0026], [0030]; Ex. 1009, [0019]-[0020], [0031], [0035]; Ex. 1003, ¶492.

A POSITA would have been motivated to improve Negishi’s battery by including the electrolyte additives of Kita and Ishikawa, forming a film on Negishi’s positive electrode to improve safety, and allowing the battery to be charged at a higher voltage to increase capacity. Ex. 1008, [0024]; Ex. 1009, [0015]-[0016]; Ex. 1003, ¶493. Accordingly, a POSITA would have been motivated to apply Kita and Ishikawa’s electrolyte additive teachings to Negishi’s battery. Ex. 1003, ¶493.

A POSITA would have also had a reasonable expectation of success in combining Negishi, Kita, and Ishikawa because Negishi, Kita, and Ishikawa disclose similar cathode, anode, and electrolyte materials, and because lithium-ion chemistry was predictable at the time of Negishi, Kita, Ishikawa, and the ’035 Patent. Ex. 1007, [0008], [0017], [0025], [0026]; Ex. 1008, [0014]-[0015], [0030]; Ex. 1009, [0019]-[0020], [0031], [0035]; Ex. 1003, ¶¶40, 494. Additionally, Negishi, Kita, and Ishikawa are all directed to improving cycle characteristics

while maintaining (or improving) battery safety. Ex. 1007, [0008], [0017], [0025], [0026]; Ex. 1008, [0014]-[0015]; Ex. 1009, [0002]; Ex. 1003, ¶494. A POSITA would have had a reasonable expectation of success in combining Negishi, Kita, and Ishikawa because Kita and Ishikawa demonstrated that a fluorine-containing carbonate ester and a fluorine-containing aromatic compound, respectively, could be added to cathode and anode materials similar to those of Negishi. Ex. 1008, [0014]-[0015], [0024]-[0026]; Ex. 1009, [0031], [0035]; Ex. 1003, ¶494. Thus, a POSITA would have expected adding the Kita and Ishikawa's electrolyte additives to Negishi's battery to be effective. Ex. 1003, ¶494.

## 2. *Claim 8*

Kita discloses a fluorine-containing organic solvent. *See supra* §VII.B.11; Ex. 1008, [0024]; Ex. 1003, ¶497.

Ishikawa discloses an “aromatic compound...capable of forming a coating on the surface of an active material of a positive or negative electrode” including examples such as “fluorobenzene, difluorobenzene, trifluorobenzene,...[and] fluoroanisole.” Ex. 1009, [0015]; Ex. 1003, ¶¶498-499.

As discussed in §VII.C(1)(ii) *supra*, a POSITA would have been motivated to combine Negishi, Kita, and Ishikawa. Ex. 1003, ¶500.

**D. GROUND 4: THE COMBINATION OF NEGISHI, KITA, AND AWANO RENDERS OBVIOUS CLAIM 7**

***1. Overview of Ground 4***

***i. Negishi, Kita, and Awano***

Negishi and Kita were described with respect to Ground 2. *See supra*

§VII.B.1.i. Awano discloses a positive electrode active material having a density of 3.5 to 4.0 g/cm<sup>3</sup>. Ex. 1029, [0033]; Ex. 1003, ¶¶503-508.

***ii. Motivation to Combine***

The motivation to combine Negishi and Kita was described with respect to Ground 2. *See supra* §VII.B.1.ii; Ex. 1003, ¶¶509-514. Negishi and Kita do not explicitly disclose a density of 3.5 to 4.6 g/cm<sup>3</sup>. Ex. 1003, ¶515.

Awano discloses that “[i]t is desirable that the pressed density of the lithium cobalt oxide of the present invention is 3.5 to 4.0 g/cm<sup>3</sup>....” Ex. 1029, [0033].

Awano discloses a similar positive electrode active material to Negishi and Kita and describes a desired property of that positive electrode active material. Ex.

1003, ¶515. Awano discloses the same types of cathode and anode materials and nonaqueous electrolyte solvents as Negishi and Kita. Ex. 1007, [0008], [0017], [0025], [0026], [0032]; Ex. 1008, [0014]-[0015], [0017], [0024]-[0026], [0030]; Ex. 1029, [0029], [0047]-[0051], [0059]; Ex. 1003, ¶517.

A POSITA would have been motivated to improve Negishi’s battery by producing a positive electrode active material with increased density to provide the

resultant batteries with “a large discharge capacity and excellent quick charge-discharge performance.” Ex. 1029, [0011]; Ex. 1003, ¶516. Accordingly, a POSITA would have been motivated to apply Awano’s density teachings to Negishi’s battery. Ex. 1003, ¶516.

A POSITA would have also had a reasonable expectation of success in combining Negishi, Kita, and Awano because all three references disclose similar cathode, anode, and electrolyte materials, and because lithium-ion chemistry was predictable at the time of Negishi, Kita, Awano, and the ’035 Patent. Ex. 1007, [0008], [0017], [0025], [0026]; Ex. 1008, [0014]-[0015], [0030]; Ex. 1029, [0029], [0047]-[0051], [0059]; Ex. 1003, ¶¶40, 517. Additionally, these references are all directed to improving cycle characteristics while improving battery safety. Ex. 1007, [0008], [0017], [0025], [0026]; Ex. 1008, [0014]-[0015]; Ex. 1029, [0011], [0022], [0047]; Ex. 1003, ¶517. A POSITA would have had a reasonable expectation of success in combining these references because Negishi contemplates the benefits of achieving “optimal filling density,” and Awano demonstrates those benefits at a higher density, e.g., 3.5 to 4.0 g/cm<sup>3</sup>. Ex. 1007, [0019], [0021]; Ex. 1029, [0011], [0033]; Ex. 1003, ¶¶517-518. Thus, a POSITA would have expected including cathode active materials at Awano’s density in Negishi’s battery to be effective. Ex. 1003, ¶518.



**1. Claim 7**

Negishi teaches battery performance improvement by achieving “optimal filling density” in its cathode active material. Ex. 1007, [0019], [0021]; Ex. 1003, ¶520. Negishi is silent on a specific density. Ex. 1003, ¶520.

Awano discloses a density of “3.5 to 4.0 g/cm<sup>3</sup>.” Ex. 1029, [0033]; Ex. 1003, ¶521. Awano’s density range falls within the range recited in Claim 7. Ex. 1003, ¶522.

**VIII. THIS PETITION CONTAINS NEW ARGUMENTS AND PRIOR ART NOT PREVIOUSLY PRESENTED TO THE OFFICE.**

The prior art here was not considered in an office action. *See* IV.B *supra*. As a result, this petition is not redundant to the original examination for purposes of 35 U.S.C. § 325(d).

**IX. THE NHK SPRING DECISION IS INAPPLICABLE.**

The claims of the ’035 Patent have never been tested in view of the most relevant prior art.

Now, and in view of the strong prior art challenges and given that the district court proceeding is in its infancy, the Board should refuse to entertain a discretionary denial under § 314(a). *See NHK Spring Co. v. Intri-Plex Techs., Inc.*, No. IPR2018-00752, Paper 8 at 19–20 (PTAB Sept. 12, 2018) (precedential). Further, the *Apple Inc. v. Fintiv, Inc.*, No. IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020), factors do not support denial of institution:

**Factor 1 (stay)** does not support discretionary denial. There are currently two district court lawsuits pending between the parties, the first filed by Petitioner in the District of New Jersey (“DNJ”) and the second filed by PO in the Waco division of the Western District of Texas (“WDTX”). In these actions, the parties filed motions to dismiss for lack of personal jurisdiction and under the first-to-file rule (or, alternatively, to transfer venue). The DNJ case is the first-filed case and the one most likely to proceed. Irrespective of the outcome of the jurisdictional disputes, Petitioner will likely move for a stay in either venue.

Even if Patent Owner argues that the WDTX action will proceed and not be stayed, the Board “will not attempt to predict how the district court in the related district court litigation will proceed.” *Sand Revolution II, LLC v. Cont’l Intermodal Grp.-Trucking LLC*, No. IPR2019-01393, Paper 24 at 7 (PTAB Jun. 16, 2020) (Informative).

**Factor 2 (Trial Date Proximity)** does not support a discretionary denial. As noted above, there is uncertainty as to which court will hear the related district court case.

If the matter proceeds (as expected) in DNJ, the matter is in its infancy as no scheduling order has been issued and no trial date has been set. If the matter proceeds in WDTX, the Court will not set the true trial date (rather than a placeholder) until *after* the *Markman* hearing. *See* Ex. 1028 (“[t]he Court expects to set [the trial date]

at the conclusion of the *Markman* hearing”). Because the *Markman* hearing will not proceed until the resolution of dispositive and transfer motions, it is likely that tentative trial date of 2/7/23 will be postponed. Ex. 1027 (the court will postpone *Markman* hearings in view of unresolved transfer motions).

Irrespective, the proximity of a trial date is not dispositive. “[Factor 2] is not considered in isolation, but holistically along with other factors.” *Facebook, Inc. v. USC IP P’ship, L.P.*, No. IPR2021-00034, Paper 13 at 11 (PTAB Apr. 30, 2021) (instituting where trial date was set five months before the Final Written Decision). Indeed, the PTAB has instituted IPR even where a district court trial is scheduled to occur five months before the PTAB’s decision where, as here, the petition was filed in the early stages of litigation. *Id.*

**Factor 3 (Investment in District Court Proceeding)** favors institution.

Investment in the district court has been minimal other than (unresolved) briefing on jurisdictional issues. In both districts very little has occurred. Invalidity contentions were served on September 10, 2021 in WDTX and are not yet due in DNJ. Indeed, all discovery (except of venue, jurisdiction, and claim construction) is stayed in WDTX until after the *Markman* hearing, which will not proceed until the resolution of the jurisdictional issues. No discovery has occurred in DNJ.

In view of the circumstances, there will have been minimal, if any, investment in the validity of the patents in the co-pending cases at time of an institution.

**Factor 4 (overlap)** favors institution.

Once jurisdiction is resolved, Petitioner will address whether a stipulation is necessary to eliminate any risk of duplicative efforts between the Board and the district court. *See, e.g., Sand Revolution II*, Paper 24 at 11-12.

**Factor 5 (Parties).** Amperex's status as both Petitioner and defendant is at best a neutral factor given above stipulation and the resultant efficiency gained by addressing the asserted grounds in this proceeding.

**Factor 6** favors institution because the grounds provide a strong showing of obviousness. *Fintiv*, Paper 11 at 14-15; *see also, e.g., VMWare, Inc. v. Intellectual Ventures I LLC*, No. IPR2020-00470, Paper 13 at 21-22 (PTAB Aug. 18, 2020).

The *Fintiv* factors weigh strongly against discretionary denial.

## **X. CONCLUSION**

Petitioner requests cancellation of the challenged claims.

**XI. MANDATORY NOTICES UNDER 37 C.F.R. §42.8**

**A. Real Party in Interest Under 37 C.F.R. §42.8(b)(1)**

The real party-in-interest is Petitioner, Amperex Technology Limited.

**B. Related Matters Under 37 C.F.R. §42.8(b)(2)**

Pursuant to 37 C.F.R. §42.8(b)(2), Petitioner is aware of the following pending lawsuits or related matters involving the '035 Patent:

- *Amperex Tech. Ltd. v. Maxell, Ltd.*, No. 2:21-cv-08461-KM-MF (D.N.J. Apr. 6, 2021).
- *Maxell Holdings, Ltd. v. Amperex Tech. Ltd.*, No. 6:21-cv-00347-ADA (W.D. Tex. Apr. 8, 2021)

Petitioner is simultaneously filing petitions for IPR of U.S. Patent Nos. 8,691,446, 9,350,019, and 9,166,251.

**C. Designation of Counsel Under 37 C.F.R. §42.8(b)(3)**

Petitioner provides the following designation of counsel.

| Lead Counsel   | Backup Counsel   |
|--|--|
| Christopher TL Douglas<br>Reg. No. 56,950<br>ALSTON & BIRD LLP<br>101 South Tryon Street, Suite 4000<br>Charlotte, NC 28280<br>Tel: 704.444.1000<br>Fax: 704.444.1111<br>Email: <a href="mailto:christopher.douglas@alston.com">christopher.douglas@alston.com</a> | Lauren E. Burrow<br>Reg. No. 70,447<br>ALSTON & BIRD LLP<br>101 South Tryon Street, Suite 4000<br>Charlotte, NC 28280<br>Tel: 704.444.1000<br>Fax: 704.444.1111<br>Email: <a href="mailto:lauren.burrow@alston.com">lauren.burrow@alston.com</a> |
|  | Madeline Byrd<br>Reg. No. 78,522   |

| Lead Counsel | Backup Counsel  |
|--------------|---|
|              | ALSTON & BIRD LLP<br>90 Park Avenue, 15th Floor<br>New York, NY 10016-1387<br>Tel: 212.210.9400<br>Fax: 212.210.9444<br>Email: <a href="mailto:maddy.byrd@alston.com">maddy.byrd@alston.com</a> |

Pursuant to 37 C.F.R §42.10(b), a Power of Attorney is being submitted with this Petition.

**D. Service Information**

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service directed to

[christopher.douglas@alston.com](mailto:christopher.douglas@alston.com), [lauren.burrow@alston.com](mailto:lauren.burrow@alston.com), and  
[maddy.byrd@alston.com](mailto:maddy.byrd@alston.com).

Date: September 23, 2021

By: /Christopher TL Douglas/  
Christopher TL Douglas

**CERTIFICATION UNDER 37 C.F.R. §42.24**

Under the provisions of 37 CFR §42.24, the undersigned hereby certifies that the word count for the foregoing Petition for *inter partes* review totals 13,985 words (Sections I-VIII), which is less than the 14,000 allowed under 37 CFR §42.24(a)(i).

Date: September 23, 2021

By: /Christopher TL Douglas/  
Christopher TL Douglas

**CERTIFICATE OF SERVICE**

Pursuant to 37 C.F.R. §§42.6(e), 42.105, the undersigned hereby certifies service on the Patent Owner of a copy of this Petition and its respective exhibits to Patent Owner via UPS Next Day Air on the correspondence address of record for U.S. Patent No. 9,077,035 as follows:

BIRCH STEWART KOLASCH & BIRCH, LLP  
8110 Gatehouse Road  
Suite 100 East  
Falls Church VA 22042-1248

Petitioner also certifies that a courtesy copy of this Petition was sent via email to Patent Owner's litigation counsel:

Abigail Lubow ([alubow@velaw.com](mailto:alubow@velaw.com))

Eric Klein ([eklein@velaw.com](mailto:eklein@velaw.com))

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Jefrey Han ([jhan@velaw.com](mailto:jhan@velaw.com))

Date: September 23, 2021

By: /Christopher TL Douglas/  
Christopher TL Douglas



Trials@uspto.gov  
571-272-7822

Paper 39  
Entered: March 28, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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AMPEREX TECHNOLOGY LIMITED,  
Petitioner,

v.

MAXELL, LTD.,  
Patent Owner.

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Patent 9,077,035 B2

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Before KRISTINA M. KALAN, WESLEY B. DERRICK, and  
ELIZABETH M. ROESEL, *Administrative Patent Judges*.

ROESEL, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
*35 U.S.C. § 318(a)*

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Patent 9,077,035 B2

## I. INTRODUCTION

### A. *Background and Summary*

Amperex Technology Limited (“Petitioner”) filed a Petition (Paper 2, “Pet.”) seeking an *inter partes* review of claims 1–11 (the “challenged claims”) of U.S. Patent No. 9,077,035 B2 (Ex. 1001, “the ’035 Patent”). Maxell, Ltd. (“Patent Owner”) filed a Preliminary Response. Paper 9. We instituted an *inter partes* review. Paper 16. After institution, Patent Owner filed a Patent Owner Response (Paper 21, “PO Resp.”), Petitioner filed a Reply (Paper 24, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 29, “PO Sur-reply”). We held an oral hearing on January 10, 2023, and a transcript is in the record. Paper 35 (“Tr.”).<sup>1</sup>

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). For the following reasons, we determine that Petitioner has shown by a preponderance of the evidence that all challenged claims of the ’035 Patent are unpatentable.

### B. *Related Matters*

The parties identify the following district court litigation as a related matter: *Maxell, Ltd. v. Amperex Tech. Ltd.*, No. 6:21-cv-00347-ADA (W.D. Tex.). Pet. 67; Paper 7, 2 (Patent Owner’s updated mandatory notices).

Also pending before us are IPR2021-01440 and IPR2021-01443, which involve the same parties and similar technology, and IPR2021-01442, which involves the same parties.

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<sup>1</sup> As agreed by the parties, oral arguments for three cases, IPR2021-01440, IPR2021-01441, and IPR2021-01443, were consolidated in a single hearing. Related case IPR2021-01442 was heard separately.

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*C. The '035 Patent (Ex. 1001)*

The '035 Patent was issued on an application filed March 16, 2007, and asserts priority based on six Japanese applications, the earliest of which was filed March 20, 2006 (the “foreign priority date”). Ex. 1001, codes (22), (30).

The '035 Patent discloses a nonaqueous secondary battery with a positive electrode having a positive electrode mixture layer, a negative electrode, and a nonaqueous electrolyte. Ex. 1001, code (57), 2:58–67. The positive electrode contains, as an active material, at least two lithium-containing transition metal oxides having different average particle sizes. *Id.*; *see also id.* at 29:24–26 (claim 1); *see also id.* at 4:6–10:36 (discussing average particle size and composition of the positive electrode active material).

Positive electrode active material (A) has the largest average particle size, for example, 5  $\mu\text{m}$  or more, and positive electrode active material (B) has the smallest average particle size, for example, 10  $\mu\text{m}$  or less. Ex. 1001, 4:30–37, 4:41–42, 4:51–52. Positive electrode active material (B) has formula (1),  $\text{Li}_x\text{M}^1_y\text{M}^2_z\text{M}^3_v\text{O}_2$ , and positive electrode active material (A) has formula (2),  $\text{Li}_a\text{M}^1_b\text{M}^2_c\text{M}^3_d\text{O}_2$ . *Id.* at 6:7–34. In these formulae,  $\text{M}^1$  represents at least one transition metal selected from Co, Ni and Mn;  $\text{M}^2$  represents at least one metal selected from Mg, Ti, Zr, Ge, Nb, Al, and Sn; and  $\text{M}^3$  represents an element other than Li,  $\text{M}^1$ , and  $\text{M}^2$ . *Id.* In formula (1),  $x$ ,  $y$ ,  $z$ , and  $v$  are defined by the equations,  $0.97 \leq x < 1.02$ ,  $0.8 \leq y < 1.02$ ,  $0.002 \leq z \leq 0.05$ , and  $0 \leq v \leq 0.05$ , and in formula (2),  $a$ ,  $b$ ,  $c$ , and  $d$  are defined by the equations,  $0.97 \leq a < 1.02$ ,  $0.8 \leq b < 1.02$ ,  $0 \leq c \leq 0.02$ , and  $0 \leq d \leq 0.02$ . *Id.* The '035 Patent discloses, for example, “a combination of the positive electrode active material (A) consisting of  $\text{LiCo}_{0.998}\text{Mg}_{0.0008}\text{Ti}_{0.0004}\text{Al}_{0.0008}\text{O}_2$ ,

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and the positive electrode active material (B) consisting of

$\text{LiCo}_{0.334}\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Mg}_{0.0024}\text{Ti}_{0.0012}\text{Al}_{0.0024}\text{O}_2$ .” *Id.* at 10:33–36.

#### *D. Illustrative Claim*

Petitioner challenges all claims 1–11 of the '035 Patent. Pet. 1.

Claim 1, reproduced below, is the sole independent claim and is illustrative of the claimed subject matter.

1. A nonaqueous secondary battery comprising:

a positive electrode having a positive electrode mixture layer, a negative electrode, and a nonaqueous electrolyte,

wherein the positive electrode comprises, as active materials, at least two lithium-containing transition metal oxides having different average particle sizes, and the lithium-containing transition metal oxide having the smallest average particle size is a lithium-containing transition metal oxide represented by the formula (1):



wherein  $\text{M}^1$  represents at least one transition metal element selected from Co, Ni and Mn,  $\text{M}^2$  represents Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn,  $\text{M}^3$  represents at least one element selected from the group consisting of Na, K, Rb, Be, Ca, Sr, Ba, Sc, Y, La, Hf, V, Ta, Cr, Mo, W, Tc, Re, Fe, Ru, Rh, Cu, Ag, Au, B, Ca, In, Si, P and Bi, and x, y, z and v are numbers satisfying the equations respectively:  $0.97 \leq x < 1.02$ ,  $0.8 \leq y < 1.02$ ,  $0.002 \leq z \leq 0.05$ , and  $0 \leq v \leq 0.05$ , and has an average particle size from 2  $\mu\text{m}$  to 10  $\mu\text{m}$ , and

the lithium-containing transition metal oxide having the largest average particle size is a lithium-containing transition metal oxide represented by the formula (2):



wherein  $\text{M}^1$ ,  $\text{M}^2$  and  $\text{M}^3$  are the same as defined in the formula (1), and a, b, c and d are numbers satisfying the equations respectively:  $0.97 \leq a < 1.02$ ,  $0.8 \leq b < 1.02$ ,

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$0.0002 \leq c \leq 0.02$ , and  $0 \leq d \leq 0.02$ , and has an average particle size from 5  $\mu\text{m}$  to 25  $\mu\text{m}$ ,

wherein said electrolyte contains a fluorine-containing organic solvent,

wherein the content of Co in the transition metal  $M^1$  of the formulae (1) and (2) is from 30% by mole to 100% by mole,

wherein the content of said lithium-containing transition metal oxide having the smallest average particle size in the lithium-containing transition metal oxides is from 5% by weight to 60% by weight,

wherein the content of said lithium-containing transition metal oxide having the largest average particle size in the lithium-containing transition metal oxides is from 40% by weight to 95% by weight, and

wherein an amount of said fluorine-containing organic solvent is 0.1% by weight to 30% by weight based on the whole weight of the electrolyte.

Ex. 1001, 29:20–30:9.

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*E. Asserted Challenges to Patentability*

Petitioner raises the following challenges to patentability.

| <b>Claim(s)<br/>Challenged</b> | <b>35 U.S.C. §<sup>2</sup></b> | <b>References/Basis</b>                 |
|--------------------------------|--------------------------------|---|
| 1–11                           | 103(a)                         | Choi, <sup>3</sup> Noh <sup>4</sup>     |
| 1–6, 9–11                      | 103(a)                         | Negishi, <sup>5</sup> Kita <sup>6</sup> |
| 8                              | 103(a)                         | Negishi, Kita, Ishikawa <sup>7</sup>    |
| 7                              | 103(a)                         | Negishi, Kita, Awano <sup>8</sup>       |

Pet. 1–2.

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<sup>2</sup> The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the ’035 Patent was filed before this date, we refer to the pre-AIA version of Title 35. Ex. 1001, code (22).

<sup>3</sup> Ex. 1005, US 2006/0257745 A1, published November 16, 2006 and filed February 15, 2006 (“Choi”). Petitioner asserts, without disagreement from Patent Owner, that Choi is prior art to the ’035 Patent under pre-AIA 35 U.S.C. § 102(e). Pet. 4.

<sup>4</sup> Ex. 1006, US 2004/0197667 A1, published October 7, 2004 (“Noh”). Petitioner asserts, without disagreement from Patent Owner, that Noh is prior art to the ’035 Patent under pre-AIA 35 U.S.C. §§ 102(a) and (b). Pet. 4.

<sup>5</sup> Ex. 1007, JP 2000-82466, published March 21, 2000, including certified English translation (“Negishi”).

<sup>6</sup> Ex. 1008, JP 2002-270238, published September 20, 2002, including certified English translation (“Kita”).

<sup>7</sup> Ex. 1009, US 2004/0142245 A1, published July 22, 2004 (“Ishikawa”).

<sup>8</sup> Ex. 1029, US 2005/0271576 A1, published December 8, 2005 (“Awano”).

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*F. Testimonial Evidence*

The record includes the Declaration of Dr. Walter van Schalkwijk (Ex. 1003) filed with the Petition, the deposition testimony of Dr. van Schalkwijk (Ex. 2016) filed with the Patent Owner Response, the Declaration of Dr. Brett Lucht (Ex. 2008) filed with the Preliminary Response, the Supplemental Declaration of Dr. Brett Lucht (Ex. 2015) filed with the Patent Owner Response, and the deposition testimony of Dr. Lucht (Ex. 1031) filed with the Reply.

II. ANALYSIS

*A. Legal Standards*

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)); *see also* 37 C.F.R. § 42.104(b) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied upon).

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved based on underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level

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of ordinary skill in the art; and (4) when presented, objective evidence of nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)). Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements,” but “must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

*B. Level of Ordinary Skill in the Art*

Petitioner contends that a person of ordinary skill in the art (“POSITA”) would have had “at least a bachelor’s degree in chemistry, chemical engineering, or materials science, as well as five or more years of experience in the field of batteries and battery materials.” Pet. 5 (citing Ex. 1003 ¶ 11). Patent Owner does not address the level of ordinary skill in the art. *See generally* PO Resp.

We find that Petitioner’s articulation of the level of ordinary skill in the art is consistent with the scope and content of the ’035 Patent and the asserted prior art. We apply Petitioner’s definition of a POSITA, with the caveat that the phrases “at least” and “or more” do not require significantly more education or experience than is explicitly set forth in Petitioner’s definition.



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*C. Claim Construction*

In an *inter partes* review, we apply the same claim construction standard as would be used by a district court to construe a claim in a civil action involving the validity or infringement of a patent. 37 C.F.R. § 42.100(b). Under that standard, claim terms are given their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history of record. *Id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–19 (Fed. Cir. 2005) (en banc); *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365–66 (Fed. Cir. 2012).

Neither party seeks express construction of any claim term. *See* Pet. 3–4; PO Resp.

We determine that no claim term requires express construction for purposes of resolving the controversy. *Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

*D. Petitioner’s Challenge based on Choi and Noh*

Petitioner contends that claims 1–11 are unpatentable as obvious based on Choi and Noh. Pet. 7–37. Patent Owner opposes. PO Resp. 2–22. We provide an overview of the references before turning to the parties’ arguments and our analysis.

*1. Choi (Ex. 1005)*

Choi discloses a composite cathode active material for a lithium battery. Ex. 1005, codes (54), (57). The composite cathode active material

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includes a large diameter active material and a small diameter active material. *Id.* at code (57), ¶¶ 10, 26, page 7 (claim 1). The large diameter active material is selected from compounds of Formulae 1 and 2, such as  $\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$ ,  $\text{LiNiO}_2$ ,  $\text{LiNi}_{0.9}\text{Co}_{0.1}\text{O}_2$ ,  $\text{LiNi}_{0.9}\text{Co}_{0.1}\text{Al}_{0.1}\text{O}_2$ , and the small diameter active material is selected from carbon-based materials, such as graphite, and compounds of Formulae 2–4, such as  $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ ,  $\text{LiMn}_2\text{O}_4$ ,  $\text{LiNi}_{0.5}\text{Mn}_{0.5}\text{O}_2$ ,  $\text{LiCo}_{0.95}\text{Mg}_{0.05}\text{O}_2$ ,  $\text{LiCoPO}_4$  and  $\text{LiNi}_{1/2}\text{Mn}_{3/2}\text{O}_4$ . *Id.* ¶¶ 10, 30–32, 39, 41, page 7 (claims 1–3).

## 2. *Noh (Ex. 1006)*

Noh discloses an electrolyte for a lithium secondary battery comprising lithium salts, a high-boiling point organic solvent, and a carbonate-based additive compound having substituents selected from a halogen, a cyano (CN), and a nitro ( $\text{NO}_2$ ). *Ex. 1006*, code (57), ¶¶ 17, 37–41. Noh discloses that the electrolyte may further comprise an organic solvent with a low boiling point or an aromatic hydrocarbon organic solvent, where the latter may be a fluorinated aromatic hydrocarbon, such as fluorobenzene. *Id.* ¶¶ 46–49. Noh discloses that the electrolyte may further comprise a swelling-inhibiting additive that includes an organic sulfone-based compound or an anisole-based compound and provides examples that include halogen-substituted compounds, including fluoro-substituted compounds. *Id.* ¶¶ 50–56. Noh's Example 1 is an electrolyte composition containing fluorobenzene as one of the solvents and fluoroethylene carbonate as the carbonate-based additive. *Id.* ¶ 64.

## 3. *Motivation to Combine*

Petitioner contends that Choi discloses a nonaqueous secondary battery including all limitations of the challenged claims, except for the

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limitations relating to a fluorine-containing organic solvent and fluorine-containing aromatic compound,<sup>9</sup> which Petitioner contends are disclosed by Noh. Pet. 7–37. Petitioner contends “a POSITA would have looked to Noh’s inclusion of a fluorine-containing organic solvent in its electrolyte to improve thermal stability” of Choi’s battery. Pet. 8 (citing Ex. 1003 ¶¶ 145–149). According to Petitioner, Noh teaches that use of a fluorine-containing carbonate-based additive compound in the electrolyte improves thermal stability and discharge characteristics of the battery. *Id.* (citing Ex. 1006 ¶¶ 33, 37, 38; Ex. 1003 ¶ 149).

Patent Owner argues that the Petition fails to allege a sufficient motivation to combine Choi and Noh. PO Resp. 2–12. According to Patent Owner, Choi and Noh disclose completely dissimilar cathode technologies, and a POSITA would not have been motivated to combine the cathode in Choi with the electrolyte in Noh. *Id.*

For the reasons discussed below, we determine that the preponderance of the evidence favors Petitioner regarding motivation to combine.

- a) Petitioner shows that a POSITA would have been motivated by a desire for increased thermal stability and improved discharge characteristics*

Petitioner shows persuasively that a desire for increased thermal stability and improved discharge characteristics would have motivated a POSITA to modify the electrolyte in Choi’s battery by including fluorine-containing additives as taught by Noh. Pet. 7–9; Ex. 1003 ¶¶ 143–150.

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<sup>9</sup> Claim 1 recites, “wherein said electrolyte contains a fluorine-containing organic solvent.” Ex. 1001, 29:53–54. Claim 8 depends from claim 1 and recites “wherein said electrolyte further contains a fluorine-containing aromatic compound other than said fluorine-containing organic solvent.” *Id.* at 30:45–48.

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Petitioner presents undisputed testimony that a POSITA “would have understood that improving thermal stability is critical to improving battery safety.” Ex. 1003 ¶ 144. The parties agree that both Choi and Noh are directed to improving thermal stability and discharge characteristics of a lithium battery. Pet. 7–8; Ex. 1003 ¶¶ 143, 144, 147; PO Resp. 6–7 (“Choi . . . addresses the problem that Noh seeks to solve by improving thermal stability and discharge characteristics.”).<sup>10</sup> For example, Choi states that “a need exists for composite cathode active materials capable of improving high voltage stability, thermal stability and high rate discharge characteristics of lithium batteries.” Ex. 1005 ¶ 7. Noh aims to provide a lithium secondary battery that does not suffer from deterioration of safety and reliability caused by swelling from gas generation during high temperature storage. Ex. 1006 ¶¶ 3, 11, 15, 16.

Furthermore, the parties agree that Choi and Noh teach different ways to improve thermal stability. PO Resp. 7 (“Choi, however, addressed thermal stability differently [than Noh], by using complex lithium-containing transition metal oxides enhanced with dopants.”); Ex. 1003 ¶¶ 143–145, 147, 148. Choi teaches a composite cathode active material that includes large and small diameter particles. Ex. 1005, code (57), ¶¶ 10, 26. According to Choi, high thermal stability is possible by using highly stable and highly conductive materials as the small diameter active materials. *Id.* ¶¶ 26, 38. Noh, on the other hand, teaches improving thermal stability and discharge characteristics by providing electrolyte additive compounds that inhibit swelling caused by generation of gas inside the

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<sup>10</sup> We omit italicization of the Choi and Noh references when quoting from Patent Owner’s briefs and declarations.

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battery. Ex. 1006, code (57), ¶¶ 15–17, 33, 37, 38, 50. According to Noh, “[t]he electrolyte improves discharge, low temperature, and cycle life characteristics of a lithium secondary battery.” *Id.* at code (57).

Petitioner shows persuasively that Noh discloses the same types of cathode and anode materials as Choi. Pet. 8 (citing, *inter alia*, Ex. 1005 ¶¶ 10, 11; Ex. 1006 ¶¶ 35, 36; Ex. 1003 ¶¶ 150, 151). Petitioner’s contention is supported by Dr. van Schalkwijk’s testimony (Ex. 1003 ¶¶ 145, 150), as well as the disclosures of Choi and Noh. Dr. van Schalkwijk testifies that Noh “teaches the same types of cathode and anode materials as Choi, namely lithium-cobalt-based oxide cathode active materials and carbon (or graphite) anode active materials.” Ex. 1003 ¶ 145.

Dr. van Schalkwijk’s testimony is supported by Choi and Noh, both of which disclose lithium-containing transition metal oxides as cathode active materials. Ex. 1005 ¶¶ 10, 11 (disclosing Formulae 1–4, which are lithium-containing oxides of cobalt, nickel, and/or manganese, and examples of these oxides); Ex. 1006 ¶ 35 (“positive active materials include a lithium-cobalt-based oxide, a lithium-manganese-based oxide, a lithium-nickel-based oxide, a lithium-nickel-manganese-based oxide”). Choi and Noh also both disclose carbon (or graphite) anode active materials. Ex. 1005 ¶¶ 53, 54, 87; Ex. 1006 ¶ 36.

Petitioner also shows persuasively that Noh “identifies limitations of these [cathode and anode] materials, including gas generation at high temperatures, which may result in thermal runaway.” Pet. 8 (citing, *inter alia*, Ex. 1006 ¶¶ 35, 36; Ex. 1003 ¶ 150). For example, Noh discloses:

Currently-used positive active materials include a lithium-cobalt-based oxide, a lithium-manganese-based oxide, a lithium-nickel-based oxide, a lithium-nickel-manganese-based oxide, and the like. The lithium-nickel-based or lithium-nickel-

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manganese-based oxide is inexpensive and represents a high discharge capacity, but has a limitation due to gas generation during high-temperature storage. However, the electrolyte of the present invention may solve the problem of deterioration of battery performance even when the lithium-nickel-based or lithium-nickel-manganese-based oxide is used as a positive active material, and a conventional carbonaceous material is used as a negative material.

Ex. 1006 ¶ 35; *see* Ex. 1003 ¶ 145 (quoting the above excerpt from Noh to show limitations of cathode active materials). As further discussed in subsection b) below, we find that Noh's teachings concerning electrolyte additives that inhibit the generation of gas inside the battery are not limited to any particular class of cathode active materials. Ex. 1006, code (57), ¶¶ 15–17, 33, 35, 37–41, 50–56.

We are also persuaded by Petitioner's contention and Dr. van Schalkwijk's testimony that Choi and Noh disclose similar electrolyte materials. Pet. 8; Ex. 1003 ¶¶ 146, 150. Both Choi and Noh teach an electrolyte solution comprising (1) a nonaqueous organic solvent such as ethylene carbonate, propylene carbonate, butylene carbonate, dimethyl carbonate, diethyl carbonate, methyl ethyl carbonate, methyl propyl carbonate, acetonitrile,  $\gamma$ -butyrolactone, dimethylformamide, and dimethylsulfoxide; and (2) a lithium salt such as  $\text{LiPF}_6$ ,  $\text{LiBF}_4$ ,  $\text{LiSbF}_6$ ,  $\text{LiAsF}_6$ ,  $\text{LiClO}_4$ ,  $\text{LiCF}_3\text{SO}_3$ ,  $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$ ,  $\text{LiC}_4\text{F}_9\text{SO}_3$ ,  $\text{LiSbF}_6$ ,  $\text{LiAlO}_4$ ,  $\text{LiAlCl}_4$ ,  $\text{LiN}(\text{C}_x\text{F}_{2x+1}\text{SO}_2)(\text{C}_y\text{F}_{2y+1}\text{SO}_2)$ ,  $\text{LiCl}$ , and  $\text{LiI}$ . Ex. 1005 ¶ 61; Ex. 1006 ¶¶ 42, 45, 49.

We agree with Petitioner that Noh teaches that use of a fluorine-containing carbonate-based additive compound in its electrolyte improves thermal stability and discharge characteristics. Pet. 8 (citing Ex. 1003 ¶ 149; Ex. 1006 ¶¶ 33, 37, 38). For example, Noh discloses:

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The carbonate-based additive compound that is added to the lithium salt-containing organic solvent with a high boiling point may inhibit swelling caused by gas generation inside the battery, and may solve problems of deterioration of the capacity and cycle life characteristics due to the use of an organic solvent with a high boiling point. . . .

The carbonate-based additive compound includes electron-withdrawing groups with high electronegativity selected from the group consisting of a halogen, a cyano (CN), and a nitro (NO<sub>2</sub>).

Ex. 1006 ¶¶ 38, 39; *see also* Ex. 1003 ¶ 147 (discussing Noh’s teaching).

As Dr. van Schalkwijk points out (Ex. 1003 ¶¶ 141, 148), Noh teaches another swelling-inhibiting electrolyte additive that may include an anisole-based compound. Ex. 1006 ¶ 50. According to Noh, the anisole-based compound “inhibits gas generation at a high temperature, and thus, decreases swelling of a battery.” *Id.* ¶ 56. Noh discloses examples of anisole-based compounds, including 3-fluoroanisole and other fluoro-substituted compounds. *Id.*

In view of the foregoing teachings of Noh, we credit Dr. van Schalkwijk’s testimony that:

In light of these disclosures [in Noh], a person of ordinary skill in the art would have been motivated to improve the properties and benefits of the Choi battery by including the aforementioned electrolyte additives of Noh to increase thermal stability (e.g., by “inhibit[ing] swelling caused by gas generation inside the battery”) and improve discharge characteristics in the resultant batteries. . . . Accordingly, a person of ordinary skill in the art would have been motivated to apply the electrolyte additive teachings of Noh to the battery of Choi to arrive an improved nonaqueous secondary battery.

Ex. 1003 ¶ 149 (citing Ex. 1006 ¶ 38).

Noh explicitly teaches that the lithium secondary batteries are in need of improved thermal stability and discharge characteristics

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and further teaches that its fluorine-containing carbonate-based additive compound and an additional fluorine-containing aromatic compound improve thermal stability and discharge characteristics of its battery. . . . In light of these teachings, a person of ordinary skill in the art would have expected the addition of the fluorine-containing carbonate-based additive compound and the additional fluorine-containing aromatic compound of Noh to the battery of Choi to be effective.

Ex. 1003 ¶ 150 (citing Ex. 1006 ¶¶ 33, 37, 38, 56, 64).

*b) Petitioner establishes a motivation to combine despite differences in cathode materials*

Patent Owner argues that Choi discloses “complex” lithium-containing transition metal oxides that “include dopants” and lead to improved charge/discharge characteristics and greater stability, as compared with conventional lithium batteries that use “basic transition metal oxides such as  $\text{LiCoO}_2$ .” PO Resp. 4–5 (citing Ex. 1005, code (57), ¶¶ 3, 4, 95, claim 1; Ex. 2008 ¶ 31). According to Patent Owner, Noh discloses “the same kind of basic lithium-containing transition metal oxides criticized in Choi as lacking [these] benefits.” *Id.* at 6 (citing Ex. 1005 ¶ 8). Patent Owner argues that “because Choi disclosed a much more complex cathode active material compared to Noh, with enhancements not even contemplated by Noh, a POSITA would not be motivated to combine these two wholly different references disclosing starkly contrasting technologies.” *Id.* (citing Ex. 1003 ¶ 31); *see also* PO Sur-reply 3–4 (similar argument).

Having considered both Petitioner’s and Patent Owner’s arguments, we are persuaded that a POSITA would have been motivated to combine the teachings of Choi and Noh as set forth by Petitioner. As discussed above, Choi and Noh both disclose lithium-containing transition metal oxides as cathode active materials. Ex. 1005 ¶¶ 10, 11; Ex. 1006 ¶ 35; *see also*



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Ex. 1003 ¶ 145 (“Noh . . . teaches the same types of cathode and anode materials as Choi.”). Patent Owner and Dr. Lucht assert that Noh does not describe the particle size of the cathode material and does not disclose “complex” lithium-containing transition metal oxides including “dopants.” PO Resp. 5–6; PO Sur-reply 2–4; Ex. 2008 ¶¶ 30, 31. Noh’s silence on particle size and dopants does not, however, mean that Noh’s cathode active material is “wholly different” from Choi’s cathode active material, as asserted by Patent Owner and Dr. Lucht. PO Resp. 6; Ex. 2008 ¶ 31. Patent Owner does not dispute that Choi and Noh both disclose lithium-containing transition metal oxides as cathode active materials. PO Resp. 5–6 (discussing Noh and citing Ex. 1006 ¶ 35); *see also* Ex. 2008 ¶ 31 (same). Moreover, Dr. Lucht does not explain how Kim’s silence on particle size and dopants would have affected a POSITA’s motivations and expectations regarding the electrolyte—the modification of Choi proposed by Petitioner. For this reason and as further explained below, Dr. Lucht’s testimony that “[t]he Choi reference and the Noh reference describe wholly different cathode active material technologies” (Ex. 2008 ¶ 31) is not sufficient to rebut Dr. van Schalkwijk’s testimony that a POSITA would have been motivated to include the electrolyte additives of Noh in the battery of Choi “to increase thermal stability . . . and improve discharge characteristics in the resultant batteries” and “would have expected the addition of the fluorine-containing carbonate-based additive compound and the additional fluorine-containing aromatic compound of Noh to the battery of Choi to be effective.” Ex. 1003 ¶¶ 149, 150.

As discussed above, Choi and Noh teach different ways to improve thermal stability. Whereas Choi’s small diameter cathode active materials confer thermal stability (Ex. 1005 ¶¶ 26, 38), Noh teaches that thermal

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stability and discharge characteristics are improved by the use of electrolyte additives for inhibiting swelling caused by gas generation. Ex. 1006, code (57), ¶¶ 15–17, 33, 37, 38, 50. At his deposition, Dr. van Schalkwijk explained:

Choi is improving thermal stability by improving the cathode itself, the cathode material. . . .

Whereas, Noh -- Noh discloses the addition of the fluorine-containing carbonate-based active compound as an electrolyte additive to improve thermal stability and discharge characteristics.

So it's doing it -- Noh is improving the battery's characteristics, thermal stability and discharge via the electrolyte and film forming on the cathode; whereas, Choi does it by altering the formulation of the cathode itself.

So now you have *two modes, one via the cathode, one via the electrolyte, of improving the thermal stability and discharge characteristics of the battery*.

Ex. 2016, 66:7–67:18 (emphasis added).

On this record, there is no evidence that Choi's dopants would have interfered with the function of the electrolyte additives taught by Noh. Ex. 1006, code (57), ¶¶ 15–17, 33, 37, 38, 50 (disclosing that electrolyte additives inhibit swelling caused by the generation of gas inside the battery). Accordingly, Patent Owner's distinction between "complex" and "basic" lithium-containing transition metal oxides (PO Resp. 4–6; Ex. 2008 ¶ 31) does not undermine Dr. van Schalkwijk's testimony that a POSITA would have been motivated to improve the thermal stability of Choi's battery by including Noh's electrolyte additives and would have expected that the addition of those additives to be effective. Ex. 1003 ¶¶ 149, 150.

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*c) Choi's improved thermal stability does not undermine  
Petitioner's showing of motivation to combine*

Patent Owner argues that a "POSITA would not have been motivated to combine . . . the electrolyte of Noh with the cathode active material of Choi because Choi already sufficiently addresses" the thermal stability problem "by using complex lithium-containing transition metal oxides enhanced with dopants." PO Resp. 6–8 (citing Ex. 2008 ¶ 31); *see also* PO Sur-reply 5–7 (similar argument).

After considering the arguments and evidence, we are persuaded by Petitioner's contention that a POSITA would have understood that thermal stability could be "***further*** improved by using an electrolyte including a fluorine-containing organic solvent." Pet. Reply 5 (citing Ex. 1003 ¶¶ 142–151; Ex. 1006 ¶¶ 33, 35–38, 64).

An expectation of further improvement is supported by undisputed evidence that Noh's electrolyte additives confer thermal stability by a ***different mechanism*** than Choi's complex lithium-containing transition metal oxides. Ex. 1003 ¶¶ 143–145, 147, 148; Ex. 1005, code (57), ¶¶ 10, 26, 38; Ex. 1006, code (57), ¶¶ 15–17, 33, 37, 38, 50; Ex. 2016, 66:7–67:18. We are persuaded by Petitioner's contention that "a POSITA would recognize that one could achieve additional benefits" by using "electrolyte additives (like Noh's)." Pet. Reply 5–6. These additional benefits that are not addressed by Choi's cathode material include "'inhibit[ing] swelling caused by gas generation inside the battery,' 'solv[ing] problems of deterioration of the capacity and cycle life characteristics due to the use of an organic solvent with a high boiling point,' and 'inhibit[ing] swelling resulting from gas generation on the negative electrode at initial charging.'"

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*Id.* at 6 (citing Ex. 1006 ¶ 33; 38, 56; Ex. 2016, 66:7–67:23; Ex. 1023,<sup>11</sup> 21–22).

We credit the above-quoted deposition testimony of Dr. van Schalkwijk (page 18, *supra*), which provides persuasive support for Petitioner’s position that Choi and Noh disclose two different modes for improving the thermal stability and discharge characteristics of the battery, one via the cathode and another via the electrolyte. Ex. 2016, 66:7–67:18. We also credit Dr. van Schalkwijk’s testimony about improving Choi’s thermal stability:

Q Choi says that it’s thermally stable. So what is there to be improved?

A Thermally stable can always be improved to be stable to a higher temperature.

*Id.* at 67:20–23. The foregoing testimony shows that a POSITA would have been motivated to modify the electrolyte of Choi to improve thermal stability even though Choi teaches that its cathode active materials improve thermal stability.

*d) Petitioner shows that a POSITA would have considered a fluorine-containing organic solvent*

Patent Owner argues that Choi discloses electrolyte compounds that “already offer the benefits of Noh’s electrolyte” and “a POSITA would not have a good reason to depart from Choi to pursue the nonaqueous electrolyte

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<sup>11</sup> R. McMillan et al., *Fluoroethylene carbonate electrolyte and its use in lithium ion batteries with graphite anodes*, J. Power Sources, 81–82, 20–26 (1999) (“McMillan”). Dr. van Schalkwijk directs us to McMillan’s disclosure concerning the benefits of a fluoro-containing electrolyte additive, fluoroethylene carbonate (“Fluoro-EC”), for lithium ion cells having a graphite anode. Ex. 1003 ¶ 223; Ex. 1023, 21–22.

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having a fluorine-containing organic solvent.” PO Resp. 8–9. According to Patent Owner, Choi discloses two mononitrile solvents (benzonitrile and acetonitrile) that offer “superior benefits to an electrolyte like Noh’s with a fluorine-containing organic solvent” and “significant benefits for improving both thermal stability and discharge characteristics.” PO Resp. 9–11 (citing Ex. 1005 ¶ 61; Ex. 2008 ¶ 34; Ex. 2015 ¶ 10; Ex. 2016, 53:15–54:10; Ex. 2017<sup>12</sup> ¶¶ 1, 41, 45); *see also* PO Sur-reply 7–8 (similar argument).

After considering the arguments and evidence, we are persuaded by Petitioner’s contention that “regardless of the alleged benefits of a mononitrile, the evidence of record provides that the fluorine-containing organic solvent of Noh would be added to the electrolyte solution of Choi.” Pet. Reply 9.

Patent Owner’s arguments are premised on an incorrect characterization of the Petition. According to Patent Owner, Petitioner proposes “substituting Choi’s electrolyte in its entirety with Noh’s electrolyte” and “incorporating just one compound from Noh into Choi’s electrolyte is not before the Board.” PO Resp. 11 (citing Pet. 9). We disagree. The Petition argues “a POSITA would have looked to Noh’s inclusion of a fluorine-containing organic solvent in its electrolyte to improve thermal stability” of Choi’s battery. Pet. 8 (citing Ex. 1003 ¶¶ 145–149). Furthermore, Dr. van Schalkwijk testifies that a POSITA “would have been motivated to improve the properties and benefits of the Choi battery by including the aforementioned electrolyte additives of Noh to increase thermal stability . . . and improve discharge characteristics in the resultant batteries” and “would have expected the addition of the fluorine-

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<sup>12</sup> US 2005/0208371 A1, published September 22, 2005 (“Kim”).

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containing carbonate-based additive compound and the additional fluorine-containing aromatic compound of Noh to the battery of Choi to be effective.” Ex. 1003 ¶¶ 149, 150. Petitioner plainly proposes modifying Choi’s battery by incorporating fluorine-containing electrolyte additives as taught by Noh. We are not limited to considering a wholesale electrolyte substitution, as argued by Patent Owner.

Furthermore, Dr. van Schalkwijk’s deposition testimony supports Petitioner’s position more strongly than Patent Owner’s. *Compare* Pet. Reply 8 (citing Ex. 2016, 54:11–13, 59:7–15), *with* PO Resp. 11 *and* PO Sur-reply 8 (citing Ex. 2016, 53:15–54:10). In the context of discussing a reference asserted in IPR2021-01440 (Koshiishi), Dr. van Schalkwijk explained that including a fluorine atom-containing compound in the electrolyte enhances and strengthens film formation at both the anode and cathode, as compared with an electrolyte with succinonitrile (a dinitrile compound) alone. Ex. 2016, 52:1–53:13; *see also id.* at 49:15–17 (introducing Koshiishi). When asked whether an additive containing a fluorine atom-containing compound could be used as a replacement for a dinitrile compound, or whether they are used together, Dr. van Schalkwijk responded that “[i]n general, they’re used together” because “the succinonitrile protects more than just the cathode; it protects the other metal surfaces in the battery.” *Id.* at 53:15–54:10. Dr. van Schalkwijk concluded, “[s]o, yes, the succinonitrile and the fluorinated compounds would be used in conjunction with each other.” *Id.* In the context of discussing the disclosure of the challenged patent in IPR2021-01440, Dr. van Schalkwijk explained that a fluorinated solvent, such as fluorinated diethyl carbonate, “is not intended as a substitute for nitrile, just a -- again, these are different

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types of molecules trying to make a film.” *Id.* at 59:2–10; *see also id.* at 54:17–59:18 (context).

We find that the foregoing deposition testimony has limited value in the current proceeding because it addresses whether a POSITA would have had a reason to add a *dinitrile* to an electrolyte that includes a fluorine-containing compound. Here, in contrast, the issue is whether a POSITA would have had a reason to add a fluorine-containing compound (as disclosed in Noh) to an electrolyte that may contain a *mononitrile* solvent (as disclosed in Choi). PO Resp. 9–11; Pet. Reply 6–9; PO Sur-reply 7–8. In this regard, we note that Noh itself teaches both a mononitrile electrolyte solvent (acetonitrile) and fluorine-containing organic solvents and additives. Ex. 1006 ¶ 45 (the high boiling point organic solvent can be, e.g., acetonitrile); *id.* ¶ 49 (the aromatic hydrocarbon organic solvent can be, e.g., fluorobenzene); *id.* ¶¶ 50, 52, 56 (the swelling-inhibiting additive can be, e.g., fluorophenylvinyl sulfone or 3-fluoroanisole).

Patent Owner relies on Kim to argue that mononitrile compounds provide safety and cycle life improvements equivalent to the dinitrile compounds disclosed in Kim. PO Resp. 11 (citing Ex. 2017 ¶ 45). We agree with Petitioner, however, that Kim is “speculative” (Pet. Reply 7), as it merely states there is a “high possibility” of equivalence between an aliphatic mononitrile and an aliphatic dinitrile. Ex. 2017 ¶ 45. Moreover, we are persuaded by Petitioner’s evidence that a POSITA would have expected better performance from a dinitrile compound than a mononitrile compound. Ex. 1032<sup>13</sup> ¶ 108, Table 1; *see* Pet. Reply 7 (discussing Abe).

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<sup>13</sup> US 2004/0013946 A1, published January 22, 2004 (“Abe”).

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Even assuming that mononitriles and dinitriles provided equivalent benefits, however, Dr. van Schalkwijk's testimony about dinitriles and fluorine atom-containing compounds does not support Patent Owner's position. Ex. 2016, 52:15–54:10, 59:7–15. Choi's disclosure of two mononitrile electrolyte solvents (Ex. 1005 ¶ 61) does not mean that Choi's battery would not benefit from the addition of a fluorine-containing organic solvent. As discussed above, Dr. van Schalkwijk's testimony demonstrates that dinitriles and fluorine-containing solvents are generally used together because they have different and complementary functionality. Ex. 2016, 53:15–54:13, 59:2–10.

Patent Owner relies on Dr. Lucht's testimony that "a POSITA would have understood that those mononitrile solvents [in Choi] offer superior benefits to an electrolyte like Noh's with a fluorine-containing organic solvent." Ex. 2015 ¶ 10. Dr. Lucht's testimony is conclusory and unsupported by any technical explanation or citation to objective evidence. For these reasons, it is outweighed by the evidence discussed above, including Dr. van Schalkwijk's deposition testimony. *See* 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight."); *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 294 (Fed. Cir. 1985) ("Lack of factual support for expert opinion going to factual determinations, however, may render the testimony of little probative value in a validity determination.").

For these reasons, we determine that Petitioner has met its burden of proof to show a motivation to combine Choi and Noh.



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#### 4. Independent Claim 1

The parties' dispute for claim 1 focuses on the composition of the lithium-containing transition metal oxides. Claim 1 recites formula (1)

$\text{Li}_x\text{M}^1_y\text{M}^2_z\text{M}^3_v\text{O}_2$  and formula (2)  $\text{Li}_a\text{M}^1_b\text{M}^2_c\text{M}^3_d\text{O}_2$ .<sup>14</sup>

Petitioner contends that claim 1's formula (1) is taught by Choi's Formula 2 and that claim 1's formula (2) is taught by Choi's Formulae 1 and 2. Pet. 12, 19–20. Choi's Formula 1 is  $\text{Li}_x\text{Co}_{1-y}\text{M}_y\text{O}_{2-\alpha}\text{X}_\alpha$ , and Choi's Formula 2 is  $\text{Li}_x\text{Co}_{1-y-z}\text{Ni}_y\text{M}_z\text{O}_{2-\alpha}\text{X}_\alpha$ , where (in both formulae)  $0.90 \leq x \leq 1.1$ ,  $0 \leq y \leq 0.9$ ,  $0 \leq z \leq 0.5$ ,  $0 \leq \alpha \leq 2$ , M is at least one selected from Al, Ni, Mn, Cr, Fe, Mg, Sr, V or rare earth elements, and X is selected from O, F, S and P. Ex. 1005 ¶¶ 10, 11.<sup>15</sup>

Patent Owner argues that Choi does not disclose three aspects of the lithium-containing transition metal oxides of claim 1: (1) the required presence of Mg and another element that satisfies  $\text{M}^2$ ; (2) the molar amount of  $\text{M}^2$ ; and (3) an element that satisfies  $\text{M}^3$ . PO Resp. 12–21.<sup>16</sup> We discuss

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<sup>14</sup> Formula (2) differs from formula (1) only with respect to the molar amounts of  $\text{M}^2$  and  $\text{M}^3$ , which are  $0.002 \leq z \leq 0.05$  and  $0 \leq v \leq 0.05$  in formula (1) and  $0.0002 \leq c \leq 0.02$  and  $0 \leq d \leq 0.02$  in formula (2), respectively. Ex. 1001, 29:39–41, 29:49–51.

<sup>15</sup> Choi's Formulae 1 and 2 differ in only two respects: (1) Formula 2 lists Co and Ni as transition metals, whereas Formula 1 lists only Co; and (2) in Formula 1, the molar amount of element M is  $0 \leq y \leq 0.9$  instead of  $0 \leq z \leq 0.5$  as in Formula 2. Ex. 1005 ¶¶ 10, 11. In both Choi Formula 1 and Choi Formula 2, however, element M could include Ni. *Id.*

<sup>16</sup> Petitioner presents essentially the same contentions for formulae (1) and (2) of claim 1, and our discussion focuses on Petitioner's contentions for claim 1's formula (1). Pet. 12–24. Patent Owner presents the same arguments for formulae (1) and (2) of claim 1. PO Resp. 21.

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each of these aspects below and then address the remaining limitations of claim 1.

*a) Element M<sup>2</sup>*

Claim 1 recites that, in formula (1), “M<sup>2</sup> represents Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn.” Ex. 1001, 29:33–35.

Petitioner contends that M<sup>2</sup> is taught by M in Choi’s Formula 2, where “M is selected from the group consisting of Al, Ni, Mn, Cr, Fe, Mg, Sr, V, rare earth elements and mixtures thereof.” Pet. 15 (citing Ex. 1005 ¶¶ 10, 11). According to Petitioner, a “POSITA would have been motivated to select Mg and Al from the elements taught by Choi.” *Id.* (citing Ex. 1003 ¶¶ 178–180; Ex. 1024<sup>17</sup>).

Patent Owner argues that Choi does not disclose the required presence of “Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn,” as recited in claim 1. PO Resp. 13–16.

For the reasons discussed below, we determine that the preponderance of the evidence favors Petitioner’s position regarding element M<sup>2</sup>.

There is no dispute that Choi discloses Mg and Al as possible constituents of a cathode active material. PO Resp. 14–15; Ex. 1005 ¶¶ 10, 11 (disclosing Formula 2,  $\text{Li}_x\text{Co}_{1-y-z}\text{Ni}_y\text{M}_z\text{O}_{2-a}\text{X}_a$ , where “M is selected from the group consisting of Al, Ni, Mn, Cr, Fe, Mg, Sr, V, rare earth elements and mixtures thereof”).

Undisputed evidence shows that a POSITA would have had several reasons to select Mg and Al from the options Choi discloses for element M.

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<sup>17</sup> S. Madhavi et al., *Cathodic properties of (Al, Mg) co-doped LiNi<sub>0.7</sub>Co<sub>0.3</sub>O<sub>2</sub>*, Solid State Ionics 152–153, 199–205 (2002) (“Madhavi”).

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These undisputed reasons include: (1) that Mg would enhance the cathode material's electronic conductivity; (2) that Al would provide structural enhancement to the cathode; (3) that Mg and Al would be less likely to disrupt the structure of the cathode material because they are the smallest elements in Choi's list; and (4) that Mg and Al would not be oxidized or reduced because they each have singular oxidation states. Pet. 15–16 (citing Ex. 1003 ¶¶ 178–180; Ex. 1024).

We credit the following un rebutted testimony of Dr. van Schalkwijk:

First, each doping element (e.g., Mg, Al, etc.) plays a different role in modifying the material properties of the host material (e.g., lithium cobalt oxide). . . . Mg atoms were first successfully doped into the  $\text{LiCoO}_2$  lattice, the result being an increase in the electronic conductivity of the material. . . . Mg doping also altered the phase transition behavior of the delithiation process, which is the removal of lithium ions from the cathode during battery charging. . . . Mg's effect was to increase the charge voltage available to the cathode; however, this was not a large effect because the solubility of Mg in the cathode was quite small, i.e. only small amounts of Mg could be doped into  $\text{LiCoO}_2$ . . . . Al was another dopant that was used at the time of Choi and the '035 Patent. . . . However, it did not enhance the conductivity of the cathode as much as the effect from Mg doping. The strength of Al was that it was able to affect the same structural enhancements to the cathode, and it was much more soluble in the cathode, i.e. more aluminum could be doped into the cathode. . . . The motivation to use two dopants (and Mg and Al were common co-dopants) was the structural enhancement of the larger concentration of Al and the electronic conductivity enhancement due to the Mg. . . .

Moreover, Mg and Al are the smallest elements in the list taught by Choi, which means that Mg and Al are less likely to disrupt the structure of the positive electrode active material. . . . Additionally, Mg and Al have singular oxidation states of +2 and +3, respectively. . . . As such, a person of ordinary skill in the art

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would have been motivated to select Mg and Al from the list of elements for “M” taught by Choi.

Ex. 1003 ¶¶ 179, 180 (citing Exs. 1022,<sup>18</sup> 1024).

We also credit Dr. van Schalkwijk’s deposition testimony explaining how Mg alters the phase transition behavior of the delithiation process “so that the battery reaction is much more reversible.” Ex. 2016, 88:22–90:4. When asked whether the other elements Choi lists for M would also have that benefit, Dr. van Schalkwijk answered that “[m]agnesium has the biggest benefit of conductivity and phase transition alteration.” *Id.* at 90:5–9. Dr. van Schalkwijk also explained how Al provides structural support to the cathode material. *Id.* at 90:10–20; *see also* Ex. 1003 ¶ 44 (explaining how Al “enhance[s] the structure and hold[s] the lithium-containing layer a bit wider” as lithium ions are removed during battery charging). When asked how the structural benefit of aluminum compares with Choi’s other elements, Dr. van Schalkwijk answered that “manganese has multiple oxidation states” and “doesn’t do anything structural,” and that chromium, iron, strontium, and vanadium either have “multiple oxidation states,” are “too large,” or both. Ex. 2016, 90:25–91:12. When asked about the rare earth elements, as listed by Choi, Dr. van Schalkwijk responded that they are “physically too large” and “most of them would be cost prohibitive.” *Id.* at 91:19–92:7; *see* Pet. Reply 10 (citing Dr. van Schalkwijk’s deposition testimony).

Dr. van Schalkwijk’s testimony is supported by Tukamoto, which discloses that Mg doping of LiCoO<sub>2</sub> can significantly increase its

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<sup>18</sup> H. Tukamoto and A.R. West, *Electronic Conductivity of LiCoO<sub>2</sub> and Its Enhancement by Magnesium Doping*, J. Electrochem. Soc. 144, 3164–168 (1997) (“Tukamoto”).

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conductivity without degrading electrochemical performance, with only a small reduction in capacity and good reversibility. Ex. 1022, 2, 6.<sup>19</sup>

Tukamoto Table I provides conductivity data for  $\text{LiCoO}_2$  with various dopants, including Al, Ni, Mn, Cr, Fe, Mg, Sr, and V, which Choi lists as options for M in Formula 2, and six rare earth elements, Sc, Y, La, Ce, Pr, and Nd, which are also options for Choi's M. *Id.* at 3. The data show that doping with Mg resulted in the highest conductivity. *Id.* ("of these various dopants only Mg led to a significant increase in conductivity").

Dr. van Schalkwijk's testimony is supported by Tukamoto's conclusion that "Mg-doped  $\text{LiCoO}_2$ , remains as a single-phase material throughout the charge/discharge cycle, in contrast to  $\text{LiCoO}_2$ , and this may lead to improved long-term stability on cycling." *Id.* at 6.

Dr. van Schalkwijk's testimony is further supported by Madhavi, which discloses that Al and Mg doping of  $\text{LiNi}_{0.7}\text{Co}_{0.3}\text{O}_2$  improves reversibility, capacity retention, and thermal stability, as compared to undoped cathode material. Ex. 1024, 1, 7. According to Madhavi, doping  $\text{LiNi}_{0.7}\text{Co}_{0.3}\text{O}_2$  with Mg and Al resulted in the formation of a single crystalline phase with a well-defined layer structure and no impurity phases. *Id.* at 2. Madhavi teaches that doping with Al and Mg provides benefits that doping with Al alone does not provide. *Id.* at 3 (Table 1 showing discharge capacity); *id.* at 6 (discussing capacity-fading); *id.* at 7 (discussing heat evolution and decomposition temperature).

Petitioner shows persuasively that using both Mg and Al as dopants provides additional benefits over using one element alone. Pet. 17 n.4

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<sup>19</sup> We cite to Exhibits 1022 and 1024 using the page numbers added by Petitioner in the lower right corner of each page.

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(citing Ex. 1017<sup>20</sup> ¶ 96, Table 2). Sato Table 2 shows that doping LiCoO<sub>2</sub> with both Al and Mg provides better charge/discharge characteristics than doping with either element alone or undoped material. Ex. 1017, Table 2.

Dr. Lucht does not controvert Dr. van Schalkwijk's testimony that the small size and singular oxidation states of Mg and Al would have prompted a POSITA to select these elements from Choi's list of options for M.

Ex. 1003 ¶ 180 (citing Ex. 1024); *see also* Ex. 2016, 97:22–99:24

(explaining why singular oxidation states for Mg and Al makes them better additive metals than the others listed by Choi). Dr. Lucht agrees that size and oxidation state of a dopant are considerations when developing a lithium-ion battery. Ex. 1031, 116:16–118:4. According to Dr. Lucht, the size of dopants should be similar to the size of the other metals “so they don't disrupt the overall crystal structure of the material.” *Id.*

at 117:16–118:4; *see* Pet. Reply 10–11 (citing Dr. Lucht's deposition testimony).

Patent Owner does not dispute Petitioner's evidence that a POSITA would have selected Mg and Al from the elements Choi teaches for M. Instead, Patent Owner argues that, in Choi's Formula 2, “M isn't required at all,” and Mg and Al are just “one pair of elements out of a possible 600 pairs of elements from Choi's list of 25 possible elements.” PO Resp. 15 (referring to Choi's list of eight elements plus seventeen rare earth elements that are options for M); PO Sur-reply 9–10 (similar argument). Patent Owner argues that Petitioner and Dr. van Schalkwijk rely on “improper hindsight bias,” that none of Choi's examples incorporates either Mg or Al, and that Choi discloses only one compound containing Mg, and that

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<sup>20</sup> US 2005/0266315 A1, published December 1, 2005 (“Sato”).

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compound does not include Al. PO Resp. 15 (citing Ex. 1005 ¶¶ 41, 65–84); PO Sur-reply 9–10.

For the reasons discussed above, we find that Petitioner and Dr. van Schalkwijk do not rely on improper hindsight bias and instead rely on undisputed evidence from before the foreign priority date of the '035 Patent showing that a POSITA would have had multiple reasons to select Mg and Al from the elements Choi teaches for M. Pet. 15–16, 17 n.4; Pet. Reply 10–11; Ex. 1003 ¶¶ 179, 180; Exs. 1017, 1022, 1024; Ex. 2016, 88:22–92:7, 97:22–99:24. Although Choi does not disclose any example compounds that contain both Mg and Al, the absence of such an example is not dispositive. *In re Mills*, 470 F.2d 649, 651 (CCPA 1972) (When evaluating obviousness, “[a]ll the disclosures in a reference must be evaluated, including nonpreferred embodiments, . . . and a reference is not limited to the disclosure of specific working examples.” (citation omitted)). Choi’s examples illustrate the effects of particle size on electrode density, discharge capacity, and thermal stability. Ex. 1005 ¶¶ 65–94. Petitioner has provided other evidence to illustrate how the selection of a dopant affects conductivity, capacity retention, and thermal stability. Ex. 1003 ¶¶ 179, 180; Exs. 1017, 1022, 1024; Ex. 2016, 88:22–92:7, 97:22–99:24.

Petitioner’s un rebutted evidence that a POSITA would have selected Mg and Al from the elements Choi teaches for M distinguishes this case from the precedent cited by Patent Owner.<sup>21</sup> PO Sur-reply 10–11. In

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<sup>21</sup> *In re Baird*, 16 F.3d 380, 383 (Fed. Cir. 1994) (“A disclosure of millions of compounds does not render obvious a claim to three compounds, particularly when that disclosure indicates a preference leading away from the claimed compounds.”).

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contrast to *Baird*, Petitioner’s evidence shows that a POSITA would have been led toward, not away from, the claimed invention.

For these reasons, we determine that Petitioner has met its burden of proof for element  $M^2$  as recited in claim 1.

*b) Molar Amount of  $M^2$*

Claim 1 recites that, in formula (1), the molar amount<sup>22</sup> of  $M^2$  is  $z$ , where  $z$  satisfies the equation,  $0.002 \leq z \leq 0.05$ . Ex. 1001, 28:48–56.

Petitioner contends that the molar amount of  $M^2$  is taught by Choi, which discloses that, in Formula 2, the subscript for  $M$  is  $z$ , where  $0 \leq z \leq 0.5$ . Pet. 16 (citing Ex. 1005 ¶¶ 10, 11). Petitioner contends that the concentration of element  $M$ , in this case  $Mg$  and  $Al$ , is a result-effective variable that would have been optimized by a POSITA’s routine experimentation. *Id.* at 16–17 (citing Ex. 1003 ¶¶ 181, 182; Exs. 1017, 1018,<sup>23</sup> 1022, 1024).

Patent Owner contends that Choi does not disclose the molar amount of  $M^2$ , as recited in claim 1. PO Resp. 16–18.

For the reasons discussed below, we determine that the preponderance of the evidence favors Petitioner’s position regarding the molar amount of  $M^2$ .

It is undisputed that Choi’s disclosed range ( $0 \leq z \leq 0.5$ ) encompasses the claimed range ( $0.002 \leq z \leq 0.05$ ), which is sufficient to establish prima facie obviousness. Pet. 16; PO Resp. 16; Ex. 1005 ¶¶ 10, 11; *E.I. DuPont de Nemours & Company v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018)

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<sup>22</sup> In formula (1), the molar amounts of the elements  $Li$ ,  $M^1$ ,  $M^2$ , and  $M^3$  are denoted by the subscripts  $x$ ,  $y$ ,  $z$ , and  $v$ , respectively. Ex. 1001, 29:31.

<sup>23</sup> US 2006/0194109 A1, published August 31, 2006 (“Watanabe”).



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(“[a] *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art” (quoting *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003))). It is also undisputed that Choi discloses a specific cathode active material containing an amount of Mg within the claimed range. Ex. 1005 ¶ 41 (disclosing  $\text{LiCo}_{0.95}\text{Mg}_{0.05}\text{O}_2$  as an example of a small diameter cathode active material); *see* PO Resp. 14 (asserting “Choi discloses only one compound containing Mg, but it does not include Al” (citing Ex. 1005 ¶ 41)).

Petitioner shows persuasively that, while Choi discloses the possibility of excluding “M” from Formula 2, a POSITA would have understood that the inclusion of Mg and Al would provide benefits and enhancements to the cathode. Pet. 16 (citing Ex. 1003 ¶ 181). We credit Dr. van Schalkwijk’s un rebutted testimony that a POSITA “would have understood that including Mg would increase the electronic conductivity of the material, alter the phase transition behavior of the de-lithiation process, and increase the charge voltage available to the cathode” and “including an additional dopant such as Al would provide structural enhancements to the cathode.” Ex. 1003 ¶ 181 (citing Exs. 1022, 1024). Dr. van Schalkwijk’s testimony is supported by the teachings of Tukamoto and Madhavi, as discussed above.

Undisputed evidence establishes that a POSITA would have understood that the concentration of Mg and Al in the cathode active material is a result-effective variable, and the optimum range of Mg and Al concentration would have been discovered by a POSITA by routine experimentation. Pet. 16 (citing Ex. 1003 ¶ 182); *see In re Applied Materials, Inc.*, 692 F.3d 1289, 1295 (Fed. Cir. 2012) (where the prior art discloses overlapping ranges, “it is not inventive to discover the optimum or

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workable ranges by routine experimentation,” if the parameter is known to be a result-effective variable) (quoting *In re Aller*, 220 F.2d 454, 456 (CCPA 1955)).

We credit Dr. van Schalkwijk’s un rebutted testimony that a POSITA would have used the smallest amount of Mg possible to stabilize the structure because the Mg does not participate in the electrochemical reaction, and it’s present at the expense of Co and/or Ni, which are electrochemically active and, therefore, contribute to the battery’s capacity.

Ex. 1003 ¶ 182 (citing Ex. 1017 ¶¶ 29, 96; Ex. 1018 ¶ 36; Ex. 1022, Fig. 6). We also credit Dr. van Schalkwijk’s deposition testimony explaining that a POSITA would have determined the smallest amount of magnesium (Mg) and aluminum (Al) that stabilizes the structure by looking at battery cycling data and X-ray or other analysis of the cathode structure to determine whether solubility limits have been reached. Ex. 2016, 104:19–106:3; *see* Pet. Reply 13 (citing this testimony).

Dr. van Schalkwijk’s testimony is supported by Tukamoto Figure 6, which compares the discharge profile (potential versus capacity) of Mg-doped cathode compositions with various Mg contents, namely  $\text{LiMg}_x\text{Co}_{1-x}\text{O}_2$ , where  $x = 0.01, 0.05, \text{ and } 0.08$ . Ex. 1022, Fig. 6. Tukamoto observes that, as the amount of Mg increases, the discharge capacity decreases, which Tukamoto attributes to reduced  $\text{Co}^{3+}$  content in the composition since “only  $\text{Co}^{3+}$  and not  $\text{Co}^{4+}$  may be oxidized upon removal of Li during charging.” *Id.* at 5. Tukamoto also observes that, “in compositions with low Mg content, e.g.,  $x = 0.01, \dots$  there is a flat potential range toward the end of the discharge cycle” and “[a]t higher Mg contents, this flat region is lost, and instead a gradual decay in potential occurs.” *Id.* at 5–6 (citing Fig. 6). Tukamoto’s observations indicate that, of the three

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cathode compositions, the one with the lowest Mg content, i.e.,  $x = 0.01$ , had the best discharge characteristics. *Id.*

Dr. van Schalkwijk's testimony is further supported by Sato, which discloses a cathode active material of the formula,  $\text{Li}_t\text{CoM}_s\text{O}_2$ , where M is "at least one element selected from Mg and Al." Ex. 1017 ¶ 27. Sato teaches that, "when s is larger than 0.03, the initial capacity is disadvantageously lowered" and "[t]herefore, it is preferred that s falls in the range:  $0 \leq s \leq 0.03$ ." *Id.* ¶ 29. Similarly, Sato teaches that

in the . . . cathode active material represented by a general formula:  $\text{Li}_t\text{CoM}_s\text{O}_2$ , when the metal M is at least one member selected from Al and Mg and s falls in the range:  $0 \leq s \leq 0.03$ , not only can the capacity retaining ratio after the 150th cycle be improved, but also the lowering of the initial capacity can be suppressed.

*Id.* ¶ 101 (discussing Table 2). Further support for Dr. van Schalkwijk's testimony is provided by Sato's disclosure of a cathode active material of the formula,  $\text{Li}_{1.00}\text{CoAl}_{0.015}\text{Mg}_{0.015}\text{O}_2$ , which Sato teaches has optimum capacity retention and initial capacity and which has a molar amount of Mg and Al ( $\text{M}^2$ ) falling within the claimed range. Ex. 1017 ¶¶ 96, 101, Table 2 (Example 8); *see* Pet. 17 n.4 (discussing Sato Table 2 and example with the above formula).

Dr. van Schalkwijk's testimony is still further supported by Watanabe, which discloses cathode active materials of the formula  $\text{Li}_x\text{Co}_{1-y}\text{M}_y\text{O}_2$ , where element M is preferably at least one of Mg, Al, and Mn, and x and y fall within the ranges  $1.0 \leq x \leq 1.03$  and  $0.005 \leq y \leq 0.15$ . Ex. 1018 ¶¶ 32, 36. Watanabe teaches that "element M contributes to stabilization of the crystal structure of the composite oxide," and to produce this effect, " $0.005 \leq y$  is required to be satisfied." *Id.* ¶ 36. Watanabe cautions that,

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“when  $0.15 < y$ , the problem of capacity degradation of the positive electrode active material arises.” *Id.*

Patent Owner does not dispute Petitioner’s evidence that a POSITA would have understood that the concentration of Mg and Al in the cathode active material is a result-effective variable that would have been optimized through routine experimentation. Instead, Patent Owner argues that “limiting the amount of the Mg-containing  $M^2$ ” to the claimed range is “critical,” that Choi’s range is “substantially larger” than the ’035 Patent’s range, and that Choi provides “no reason to select an amount of  $M^2$ ” within the claimed range. PO Resp. 16–17 (citing Ex. 1001, 7:48–50, 8:16–18; Ex. 2008 ¶¶ 39–41); PO Sur-reply 10–11.

In IPR proceedings,

“where there is a range disclosed in the prior art, and the claimed invention falls within that range, the burden of production falls upon the patentee to come forward with evidence” of teaching away, unexpected results or criticality, or other pertinent objective indicia indicating that the overlapping range would not have been obvious in light of that prior art.

*DuPont*, 904 F.3d at 1008 (quoting *Galderma Labs., L.P. v. Tolmar, Inc.*, 737 F.3d 731, 738 (Fed. Cir. 2013)). Here, Patent Owner does not meet its burden to produce evidence of non-obviousness of the claimed range for the molar amount of  $M^2$ .

Patent Owner directs us to the ’035 Patent’s teachings that, by requiring Mg, “the safety of the battery is more effectively improved,” but that a large quantity of Mg should be avoided because “the load characteristic of the battery tends to decrease.” PO Resp. 16 (citing Ex. 1001, 7:48–50; 8:16–18); PO Sur-reply 11 (same). We agree with Petitioner, however, that these teachings are *not* unexpected. Pet.

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Reply 12–13. The un rebutted evidence discussed above demonstrates that a POSITA would have known to use as small an amount of Mg and Al as necessary to stabilize the structure without substantively interfering with the electrochemical reaction and also would have understood that amounts within the claimed range would provide these beneficial results. Ex. 1003 ¶¶ 181, 182; Ex. 1017 ¶¶ 29, 96, 101, Table 2; Ex. 1018 ¶ 36; Ex. 1022, Fig. 6; Ex. 2016, 104:19–106:3. Petitioner’s evidence meets the applicable legal standard, which does not require identifying disclosure of the optimum or workable ranges in the prior art. *In re Aller*, 220 F.2d at 456 (“[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.”).

Furthermore, Patent Owner presents no data, comparative or otherwise, to back up the statements in the ’035 Patent regarding safety and load characteristics of the battery. Patent Owner’s reliance on conclusory statements in the specification is not enough to satisfy its burden to come forward with evidence of unexpected results or criticality. *In re De Blauwe*, 736 F.2d 699, 705 (Fed. Cir. 1984) (“It is well settled that unexpected results must be established by factual evidence. Mere argument or conclusory statements in the specification does not suffice.”). We have also considered Dr. Lucht’s testimony. Ex. 2008 ¶¶ 39–41. Dr. Lucht relies on the same specification statements and presents no objective evidence of unexpected results or criticality for the molar range for M<sup>2</sup>. *Id.* Dr. Lucht’s testimony is therefore not sufficient to satisfy Patent Owner’s burden of production. *See In re Lindner*, 457 F.2d 506, 508 (CCPA 1972) (mere conclusory statements in the specification and affidavits are entitled to little weight and are not sufficient to show unexpected properties for the claimed compositions).

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For these reasons, we determine that Petitioner has met its burden of proof for the molar amount of  $M^2$  as recited in claim 1.

*c) Element  $M^3$*

Claim 1 recites that, in formula (1), “ $M^3$  represents at least one element selected from the group consisting of Na, K, Rb, Be, Ca, Sr, Ba, Sc, Y, La, Hf, V, Ta, Cr, Mo, W, Tc, Re, Fe, Ru, Rh, Cu, Ag, Au, B, Ca, In, Si, P and Bi.” Ex. 1001, 29:35–38. Claim 1 further recites that, in formula (1), the molar amount of  $M^3$  is “v,” where “ $0 \leq v \leq 0.05$ .” *Id.* at 28:39–41.

Petitioner contends that  $M^3$  is taught by X in Choi’s Formula 2, where “X is selected from . . . O, F, S and P,” asserting that “Choi teaches ‘P’ as  $M^3$ .” Pet. 17 (citing Ex. 1005 ¶¶ 10, 11). Petitioner asserts that the amount of element  $M^3$  in formula (1) in claim 1 may be zero and that Choi similarly teaches that the amount of element X in Formula 2 may be zero. Pet. 18 (citing Ex. 1001, 9:24; Ex. 1005 ¶¶ 10, 11). Petitioner contends that a POSITA would have omitted element X from Choi’s Formula 2 to make it easier to synthesize. Pet. 18 (citing Ex. 1003 ¶ 184).

Patent Owner argues that Choi does not disclose element  $M^3$ , which “must be a metal,” and Choi “requires that X be a nonmetal.” PO Resp. 18–19 (citing Ex. 1001, 9:25–34; Ex. 2008 ¶ 43). In addition, Patent Owner argues that “[n]othing disclosed in Choi about X matters, because X must be excluded for Choi to provide an  $O_2$  oxide like the ’035 Patent.” *Id.* at 20 (citing Ex. 2015 ¶ 11).

For the reasons discussed below, we determine that the preponderance of the evidence favors Petitioner’s position regarding element  $M^3$ .

We agree with Petitioner that it would be improper to read  $M^3$  as limited to a metal. Pet. Reply 13. The portion of the ’035 Patent

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specification cited by Patent Owner (Ex. 1001, 9:25–34) merely provides examples of element  $M^3$  and does not demonstrate either patentee lexicography or a disavowal of claim scope. *Thorner*, 669 F.3d at 1365 (“To act as its own lexicographer, a patentee must ‘clearly set forth a definition of the disputed claim term’ other than its plain and ordinary meaning.”); *id.* at 1365 (“The standard for disavowal of claim scope is similarly exacting.”). Understanding  $M^3$  as not limited to a metal is consistent with the specification’s description of elements  $M^1$ ,  $M^2$ , and  $M^3$ , where  $M^1$  represents a “transition metal element,”  $M^2$  represents a “metal element,” and  $M^3$  represents “an element other than Li,  $M^1$  and  $M^2$ .” Ex. 1001, 6:12–16, 9:17–20.

Regardless of the breadth of element  $M^3$ , however, there is no dispute that formula (1) in claim 1 can omit element  $M^3$  altogether and that Choi similarly discloses that Formula 2 can omit element X. Pet. 18; PO Resp. 20–21 (“Choi teaches that the value of  $\alpha$  (indicating the amount of X) is  $0 \leq \alpha \leq 2$ ” and “the amount ‘v’ for  $M^3$  can be in the range  $0 \leq v \leq 0.05$ , meaning that  $M^3$  could be excluded”). In other words, element  $M^3$  is **optional** in claim 1, and Choi’s element X is likewise optional. See Ex. 1001, 9:20–24 (disclosing that the cathode active material “may contain no  $M^3$ ”).

Furthermore, undisputed evidence demonstrates a POSITA would have had a reason to omit X in Choi’s Formula 2. Dr. van Schalkwijk testifies that a POSITA “would have understood that by setting ‘ $\alpha$ ’ at 0, [Choi’s] Formula 2 would provide an oxide  $O_2$ , as the value of oxygen in Formula 2 (‘ $O_{2-\alpha}$ ’) is dependent upon the value of ‘ $\alpha$ .’” Ex. 1003 ¶ 184 (citing Ex. 1005 ¶¶ 10, 11). Patent Owner and Dr. Lucht agree that, when the value of “ $\alpha$ ” is zero, Choi’s Formula 2 is an oxide  $O_2$ . PO Resp. 20;

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Ex. 2015 ¶ 11. We credit Dr. van Schalkwijk’s unrebutted testimony that a POSITA “would have understood that providing an oxide would make the positive electrode active material easier to synthesize because [if X were included] extra materials would have to be carefully added to the formulation to substitute for any amount of oxygen.” Ex. 1003 ¶ 184. Dr. van Schalkwijk’s testimony is consistent with Choi’s exemplary cathode active materials, all but one of which are oxides that omit element X. Ex. 1005 ¶¶ 39, 41; *see also* Ex. 1017 ¶ 39 (describing a method of synthesizing a lithium-transition metal composite oxide).

For these reasons, we determine that Petitioner has met its burden of proof for element M<sup>3</sup> as recited in claim 1.

*d) Remaining Limitations of Claim 1*

Based on the undisputed argument and evidence presented by Petitioner, we find that Choi teaches or suggests all remaining limitations of claim 1, except for the limitations reciting a fluorine-containing organic solvent, which are taught or suggested by Noh. Pet. 9–15, 18–21, 24–28; Ex. 1003 ¶¶ 152–177, 185–196, 204–211, 218–244; Ex. 1005 ¶¶ 9–11, 17, 18, 34, 39, 41, 46–48, 52, 61, 62, 65, 73–76, 86, Fig. 2; Ex. 1006 ¶¶ 32, 37, 39–41, 45, 64, 65.

*5. Dependent Claims 2–11*

Petitioner contends that the additional limitations of dependent claims 2–7, 10, and 11 are taught or suggested by Choi and the additional limitations of dependent claims 8 and 9 are taught or suggested by Noh. Pet. 28–37. Patent Owner does not present arguments for dependent claims 2–11 apart from its arguments for independent claim 1. *See* PO



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Resp. 13 (asserting that “[d]ependent claims 2–11 depend from claim 1 and, due to their dependence on claim 1, these claims are not obvious”).

Based on the undisputed argument and evidence presented by Petitioner, we find that Choi teaches or suggests the additional limitations of dependent claims 2–7, 10, and 11 and that Noh teaches or suggests the additional limitations of dependent claims 8 and 9. Pet. 28–37; Ex. 1003 ¶¶ 245–322; Ex. 1005 ¶¶ 10, 11, 40, 45, 61, 73, 75, 76, 88; Ex. 1006 ¶¶ 37, 39, 50, 54–56, 64; Exs. 1017, 1018, 1022. For the same reasons as set forth above for independent claim 1, we determine that Petitioner has met its burden of proof for the limitations of dependent claims 2–11 that are incorporated by reference. *See* 35 U.S.C. 112, para. 4 (2006) (“A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.”).

#### 6. *Conclusion for Petitioner’s Challenge based on Choi and Noh*

We determine that Petitioner has shown by a preponderance of the evidence that claims 1–11 are unpatentable as obvious based on Choi and Noh.

#### E. *Petitioner’s Negishi-led Challenges*

Because we determine that Petitioner has shown that all challenged claims are unpatentable based on Choi and Noh, we do not reach Petitioner’s challenges based on Negishi and Kita, by themselves or with Ishikawa or Awano. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App’x 984, 990 (Fed. Cir. 2020) (nonprecedential) (“We agree

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that the Board need not address [alternative grounds] that are not necessary to the resolution of the proceeding.”).

### III. CONCLUSION

In summary:

| <b>Claim(s)</b>        | <b>35 U.S.C. §<sup>24</sup></b> | <b>References</b>       | <b>Claims Shown Unpatentable</b> | <b>Claims Not Shown Unpatentable</b> |
|------------------------|---------------------------------|-------------------------|----------------------------------|--------------------------------------|
| 1–11                   | 103(a)                          | Choi, Noh               | 1–11                             |                                      |
| 1–6, 9–11              | 103(a)                          | Negishi, Kita           |                                  |                                      |
| 8                      | 103(a)                          | Negishi, Kita, Ishikawa |                                  |                                      |
| 7                      | 103(a)                          | Negishi, Kita, Awano    |                                  |                                      |
| <b>Overall Outcome</b> |                                 |                         | 1–11                             |                                      |

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<sup>24</sup> We do not reach Petitioner’s challenges based on Negishi and Kita, by themselves or with Ishikawa or Awano, because we determine that Petitioner has shown that all challenged claims are unpatentable based on Choi and Noh.

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#### IV. ORDER<sup>25</sup>

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–11 of the '035 Patent are unpatentable; and

FURTHER ORDERED that because this Decision is final, a party to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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<sup>25</sup> Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*, 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

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